statoil

PETROPHYSICAL EVALUATION

WELL 34/10-7 AND 34/10-9

FORMATION: COOK AND STATFJORD

BY: PETROLEUM ENGNINEERING
PETROPHYSICAL GROUP

Den norske stats oljeselskap a.s

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FEBRUARY 1981

ENG: T. HELGØY

General well data

Norway offshore

Licence	:	050	050
Wildcat well	:	34/10-7	34/10-9
Location	:	61° 12' 13.44"N 02° 16' 28.50"E	61° 12' 55.30"N 02° 15' 00.50"E
Spudded	:	7.1.1980	24.3.1980
Rig released	:	24.4.1980	3.7.1980
KB-elevation	:	25 m	25 m
Water depth	:	204 m	203 m
Total depth	:	2250 m	2202 m
Objective	:	Jurassic sandstone	
Operator	:	Statoil	
Partners	:	Norsk Hydro, Saga Petroleum	
Status	:	Plugged and abandoned	

Introduction

This report covers the petrophysical evaluation of the Cook- and Statfjordformation in well 34/10-7 and the Cook-formation in well 34/10-9.
The main target for both these wells were to test the Jurassic sandstone formations for hydrocarbon accumulations. 34/10-7 is a surprice in the way that the whole Brent sequence has been eroded.

Summary

Both the Cook-formation (1810 - 1937) and the Statfjordformation (2053 - 2165) encountered hydrocarbons in the 34/10-7 well.
No oil/water-contract was found in the Cook-formation for this well but in the Statfjordformation the oil/water-contact is found to be ± 2066 m RKB. Cook encountered 79.5 m of Net Sand. The net-pay has an average porosity of 27.4% and average watersaturation 32.8%.
The Statfjordformation in this well encountered 92 m of Net Sand but only 6.5 m of this is hydrocarbon-bearing. Average porosity for the total net sand is 24% and it is waterbearing below 2066 m.

The 34/10-9 well encountered 55 m of Net sand in Cook (2083 - 2203), but only 15 m of these are hydrocarbon-bearing. The Net-Pay sectioction has an average porosity of 28% and a watersaturation of 39%. An oil/water contact is found to be at ± 2107 RKB, but some residuels seems to exist below this depth.

LITHOLOGY

The Cookformation is devided into three sections:

	Cook 3	Cook 2	Cook 1
34/10-7	1810-1825	1825-1882	1882-1937
34/10-9	2083-2097	2097-2150	2150-2203

Cook 3 : Storm deposites, very little grain variation, laminated with clay/shale

Cook 2 : Upper shore face. Coarsing upwards sequence. Some tight carbonate, cemented zones

Cook 1 : Lower shore face. Coarsing upwards sequence · silt grading into clay. Some tight carbonate, cemented zones.

STATFJORD FM.

34/10-7 (2053 - 2165) : Interbedded shale and sandstone fluvial dominated.

INPUT PARAMTERS

Input parameters to the calculations have been picked from cross-plots, measured data and empirical relations.

FORMATION WATER SALINITY

No water-samples are available from test neither in Cook or in Statfjord. Log-analysis indicates the salinity to be about the same in Cook and Statfjord. The following values have been used for formation water resistivity under reservoir conditions.

Cook fm.	0.07 Ωm	at	160°F
Statfjord fm.	0.065Ωm	at	160°F

Formation temperature

A constant temperature have been used in the computations for each formation.

Cook	:	160°F
Statfjord	:	160°F

Mud properties:

	at 68°F	at reservor condit.
34/10-7 Cook	Rmf = 0.24	0.105 Ωm
	Rm = 0.48	0.23 -"-
	Rmc = 1.06	0.50 -"-
	* 25000 ppm NaCl	

	at 56°F	at reservoir condit.
34/10-9 Cook	Rmf = 0.23	0.105 Ωm
	Rm = 0.46	0.22 Ωm
	Rmc = 1.12	0.52 Ωm
	* 23000 ppm NaCl	

	at 68°F	at reservoir condit.
34/10-7 Statfjord fm.	Rmf = 0.24	0.105 Ωm
	Rm = 0.48	0.23 -"-
	Rmc = 1.06	0.50 -"-

Resistivity

For the Cook-formation the DLL-curves have been corrected according to an inhouse correction program similar to the tornado-diagrams.

Statfjord formation.

R_{ILD} (6FF40) has been used as Rt. No R_{xo} available (SXO = 1)

Shale parameters

Shale parameters have been selected from crossplots and visual inspection of the logs. High content of K-feltspar, mica and glauconite increase the GR-reading. The table below lists the paramters used for each formation

formation	ϕ_{NSH}	ρ_{bSH}	R_{CL}	GR_{min}	GR_{max}
Cook	0.42	2.4	1.1	50	80
Statfjord	0.42	2.4	1.1	28	80

Computations

Shale volume

Gamma Ray and FDC/CNL crossplots have been used for V_{sh} calculations in both formations. Where both indicators have been used, the minimum value have been picked as V_{sh}.

Porosity - calculation in Cook.

We know from the literature that the measurement of helium porosity in the laboratory gives the total porosity (ϕ_t). This can thus be used to calibrate the density log which also reflects total porosity.

Effective porosity (ϕ_e) is the total porosity minus the fraction of the bulk volume occupied by CBW (clay-bound water). We therefore say:

$$\phi_e = \phi_t - \phi_{cbw} \qquad (1)$$

The total porosity calibration to the density - log is based on the assumption that ρ_{cbw} = 1 g/cc and that ρ_{cl} (dry) for sand is about equal to ρmatrix.

By the work of Hill, Shirley and Klein it is found that the amount of clay-hydrated water W_s (g water/g dry rock) is proportional to the cationexchange capasity of the rock, CEC (meq/g dry rock) and inversely proportional to the salinity, Co (meq/cm^3) of the NaCl salution in equilibrium with the sample:

$$Ws = (0,084 \cdot Co^{-1/2} + 0,22) \cdot CEC_{cl} \qquad (2)$$

Expressing Ws in terms of volume water per volume dry rock ($Ws \cdot \rho m/\rho_{CBW}$), dividing by ϕ_t and combining with equation 1 we have:

$$\Phi e = \Phi_t \cdot \left[1 - (0.084 \cdot Co^{-\frac{1}{2}} + 0.22) \cdot Q_v \frac{1}{CBW} \right] \qquad (3)$$

ρ_{CBW} is assumed to be unity and if equation 1 is rearranged we find:

$$\frac{\Phi_e}{\Phi_t} = 1 - \frac{\Phi_{CBW}}{\Phi_t}$$

Equation (3) can also be written:

$$\frac{\Phi_e}{\Phi_t} = 1 - (0.084 \cdot Co^{-\frac{1}{2}} + 0.22)\ Q_v \qquad (4)$$

The effective porosity can also be found by applying the V_{CL} (dry) consept.

$$\Phi_e = \Phi_t - V_{CL}(dry)\ \frac{\Phi_{CL}\ (CBW)}{1 - \phi_{CL}\ (CBW)}$$

Φ_{CL} (CBW) - the porosity of a pure, hypothetical clay containing clay particles and CBW only.

A reliable assessment of Q_v in complex lithologies is based on the following equation:

$$Q_v = \frac{V_{CL(dry)} \cdot \rho_{CL(dry)} \cdot CEC_{CL}}{\Phi_t} \quad (meq/cm^3) \qquad (6)$$

$V_{CL(dry)}$ - the "dry clay" content of the formation in terms fraction BV.

$\rho_{CL(dry)}$ - the average density of the clay mineral mixture (g/cm^3) present in the formation.

CEC_{CL} - the cation-exchange - capasity of the average clay-mineral mixture present in the formation (meq/g dry clay).

ϕ_t - total porosity as derived from the density-log.

The V_{CL} (dry) can be estimated by the formula:

$$V_{CL(dry)} = \frac{\phi_N - \phi_D}{HI_{CL(dry)}} \qquad (7)$$

ϕ_N - CNL porosity corrected for lithology effects (not for shale) and Hydrocarbon-effects.

$HI_{CL(dry)}$ - the hydrogen index (fraction HI water) of the average dry clay-mineral mixture present in the formation.

The reasoning behind equation (7) is as follows:

1) the calibrated FDC-log sees all the water present in the formation,
2) the calibrated CNL also sees all the water present in the formation and in addition, it responds to the hydrogen atoms buildt into the lattice of the solid clay minerals (in forms of OH^- groups),
3) the difference $\phi_N - \phi_D$ is thus the incremental hydrogen index (ΔHI) of the formation resulting from the (dry) clay minerals present in it,

4) the hydrogen index of the clay-mineral mixture ($HI_{CL(dry)}$) can be calculated on the bases of the clay mineralogy in close coorporation with the laboratory and the geologist,
5) the ratio $\Delta HI/HI_{CL(dry)}$ therefore represents the amount of dry clay present in the formation.

Going back to the original equation for Q_v given by Waxman and Smit it is:

$$Q_V = \frac{CEC \cdot \rho_{mat} (1 - \phi_t)}{\phi_t \cdot 100} \quad (meq/cm^3)$$

The new approach indicates that the Q_V - $\emptyset$ relationship on log-log transformation is not a straight line. By adding the V_{CL} (dry) into the equation the surface area of the clays are introduced as a function of the adsorption of water creating OH^- groups. This comes instead of the $(1 - \emptyset_t)$ in the general equation and this should give a better response to Q_v because we now have boths V_{CL} (dry) and CEC_{CL}.

Applying equation 6 in equation 4 it is evident that we find:

$$\phi_e = \phi_t - V_{CL(dry)} \; (0.084 \cdot Co^{\frac{1}{2}} + 0.22) \cdot CEC_{CL} \cdot \frac{\rho_{CL(dry)}}{\rho_{CBW}}$$

$\rho_{CBW} = 1$
$\rho_{CL(dry)} =$ ρmat (g/cc in most cases (sand) at least for kaolinite.

The equation ends up in its final form:

$$\phi_e = \phi_t - V_{CL(dry)} \left[(0.084 \cdot Co^{-\frac{1}{2}} + 0.22) \; CEC_{CL} \cdot \rho_{CL(dry)}\right]$$

Porosity-calculation in the Statfjordformation.

The porosity has been calculated with a complex lithology method using density and neutron logs with the following matrix parameters.

	FDC	CNL
Quartz	2.66	-0.035
Heavy mineral	2.9	.25
Fluid	1.0	1.0

Formation Factor

No measurements are available from the Cook or the Statfjordformation, which could give values for formation factor. Therefore the values that are used in the Brent-formation have been applied also for these formations. The Humbe relation is used and the equation is:

$$F = 0.62 \times \emptyset^{-2.15}$$

Saturation exponent

Core measurements give an average value of 1.95 in the Brent formation for the saturation exponent. Therefore we are using a standard value of 2.0 in both the Cook and the Statfjordformation.

Watersaturation

The equation recommended by Schlumberger for the North Sea is used and have the following equation.

$$\frac{1}{R_t} = \left(\frac{(VSH)^c}{\sqrt{R_{CL}}} + \frac{\emptyset^{m/2}}{\sqrt{a \cdot R_w}}\right) Sw^{n/2}$$

R_t	=	resistivity of the vergine zone
S_w	=	watersaturation in fraction
V_{SH}	=	volume of clay
C	=	clay exponent (1.6 used)
R_{CL}	=	resistivity of clay
$\emptyset$	=	porosity in fraction
m	=	cementing exponent
n	=	saturation exponent
a	=	lithology constant
R_w	=	formation water resistivity

Results from using the porosity model on 34/10-7 and 34/10-9 in the Cook-formation.

The correlation between core-data and density-log has been done (fig. 1 and 2) giving the total porosity $\emptyset_t$ using the equation

$$\emptyset = \frac{\rho_{mat} - \rho_{log}}{\rho_{log} - \rho_{fluid}}$$

To be able to understand the $\emptyset_t$ - $\emptyset_e$ consept it is evident that the caliper-log must be a guide to the interconnected flowing pore-system. Where the caliper shows mudcake there have to be permeability and hence effective porosity. Therefore the zones having mudcake should be the same zones as those calculating effective porosity above spesified limits.

We know that the salinity of the formations water is 40 g/cc. Assuming that ρ_{CL} (dry) = ρ_{mat} = 2.67 g/cc, the only unknown in the $\emptyset_e$ equation is the CEC_{CL}, hence the calculation of $\emptyset_e$ is a function of the cation-exhange - capasity and the Hydrogen index. By trail and error it has been found that the value to use in the equation $\emptyset_e = \emptyset_t - X \times V_{CL\ (dry)}$ has to be $0.12 < x < 0.13$ to mach the caliper build-up. Examples are given in figure 3 - 7.

From the porosity obtained from the FDC and the porosity that the CNL shows, we calculate $V_{CL\ (dry)}$ using a HI_{CL} (dry) of .25 because it seems that the Cook formation is a mixture of quartz, k-feltspar, mica, kaolinite and Glauconite. The change on the CNL going from limestone to sandstore is set to 4%.

The final calculation is carried out using the equation $\emptyset_e = \emptyset_t - x \cdot\cdot V_{cl\,(dry)}$ with x = 0.12. The curves are presented on the graphical log-presentation fig. (26-27)

Correcting Net/Gross ratio using HDT.

The high resolution dipmeter tool (HDT) have been used to correct the FDC-log for lack of resolution. It is especially in 34/10-7 (Cook 3) that this log has found its us. The background for using the HDT is that it is a micro-device which reads just behind the mudcake and has 10 readings for each inch. Therefore it sees all the thin lamina of clay/shale or limestone/shale that should give marked responses on the resistivity curves that the HDT produces. Using now these curves we can produce a corrected FDC that we use for the porosity evaluation. By doing it this way the produced Net/Gross ratio is much more in line with what is seen on the core. The curves are plottet on the summary-log (fig. 28) giving a visual presentation of the corrected data plus the HDT.
For the 34/10-9 well the lamination is not that severe and therefore the FDC-log has not been corrected for this effect. fig. (29).

Results table of Petrophysical parameters in Cook.

WELL	FORMATION	INTERVAL RKB (m)	NET/PAY / NET SAND	AVERAGE POROSITY %	AVERAGE Sw %	NET/GROSS RATIO
34/10-7	Cook-3	1810-1825	10.75	0.316	0.169	0.716
34/10-9	Cook-3	2083-2097	11.25	0.294	0.32	0.857
34/10-7	Cook-2	1825-1882	45 / 53	0.264 / 0.25	0.366 / 0.427	0.78 / 0.92
34/10-9	Cook-2	2097-2150**	3.5 / 16.25	0.237 / 0.225	0.61 / 0.73	0.06 / 0.43
34/10-7	Cook-1	1882-1900*	0 / 15.5	0 / 0.149	1 / 0.90	0 / 0.86
34/10-9	Cook-1	2150-2175*	0 / 2.25	0 / 0.26	1.0 / 1.0	0 / 0.09
34/10-7	Statfjord	2053-2142	6.5 / 92	0.27 / 0.24	0.39 / 1.0	0.812 / 0.48

Cut-off criterion:

VSH > 100%
PHIF < 12%
SW > 65%

Table 1

NET PAY / NET SAND

* The digitized part of Cook 1.
** net sand only down to 2133.5 m RKB (see chapter on permeability)

Permeability

A core to core data correlation have been done in the Cook-formation to make a porosity permeability correlation. The helium porosity has been plotted against the horisontal liquid permeability for both the 34/10-7 and 34/10-9 well. Because there are very few plugs cut from Cook-3, all the data available have been used to generate a line pr well for the Cook-formation. The equations obtained from these plots are:

34/10-7	$\emptyset = 0.04669 \times \log K + 0.2639$	Fig. 22
34/10-9	$\emptyset = 0.03080 \times \log K + 0.2490$	Fig. 23

Both these plots indicate that the cut-off values used generally can not apply to Cook because under 1 md we do not feel that producable hydrocarbons exist. The value of 1 md correspond to a value of 25% total porosity and that is higher than what has been used before.

In the hydrocarbon-bearing section of both 34/10-7 and 34/10-9 no change is applied to the average petrophysical parameters by introducing these new cut-offs. But in the water sands or in the sands with high watersaturation it seems like diagenetic prosesses have changed the porevolum after the hydrocarbons accumulated into the structure. Therefore all the waterzones will have very low permeability with values around 1 md or less. Therefore the section below 2133.5 m RKM in 34/10-9 is considered not to be net-sand because the permeability is 1 md or less
The lowest part of 34/10-7 is also near to cut-off criteria but is kept in sience the porosity is in access of 25%, but the permeability is very bad in the section.

No permeability relation has been developed for the Statfjordformation sience very few datapoints exist in this formation.

PERMEABILITY AVERAGE FROM LOGS

WELL	INTERVALL	ARITMETHIC AVERAGE	HARMONIC AVERAGE PERMEABILITY(MD)
34/10-7	1810-1825	540 md	—
34/10-7	1825-1882	30 md	—
34/10-7	1882-1900	0	0
34/10-9	2083-2097	1121 md	—
34/10-9	2097-2150	10.16 md	—
34/10-9	2150-2175	0	0

EQUATION USED FOR PERMEABILITY PREDICTION:

34/10-7 $\emptyset = 0.04669 \times \log k + 0.2639$

34/10-9 $\emptyset = 0.03\text{-}80 \times \log k + 0.2490$

34/10- DRILL-STEM TEST IN THE COOK FORMATION.

WELL	TEST	INTERVAL	CHOKE	OIL-RATE	GAS-RATE	GOR
34/10-7	1	1833-1840	40/64"	2963 STB/D	2.08 MMSCF/D	705 SCF/D
34/10-9	1	2078-2084	20/64"	264 "	104 MSCF/D	390 "
34/10-9	2A	2059-2065	32/64"	4755 "	1.72 MMSCF/D	363 "

References:

1. Hill, Shirley and Klein.
Bound water in shaly sands - its relation to Qv and other formation properties.

2. I. Juhász. (Shell, Haag)
The central role of Qv and formation-water salinity in the evaluation of shaly formations.

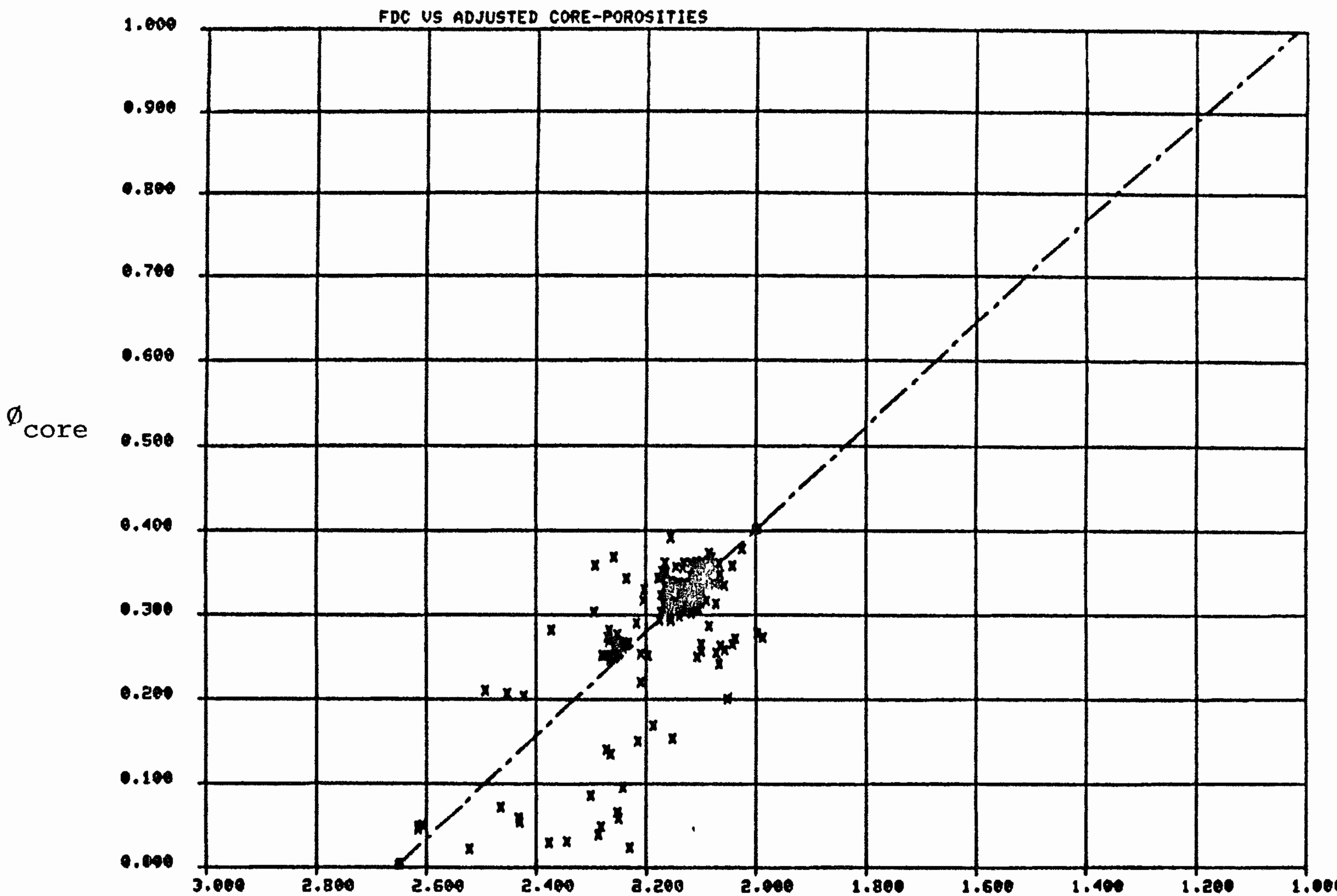
3. William R. Almon. (Cities Service Company)
A geologic Appreciation of shaly Sand.

APPENDIX

- Crossplots log vs log
  permeability vs porosity
  log vs core
  histograms
- Summary log
- CPI

34/10-7 COOK

Fig. 1



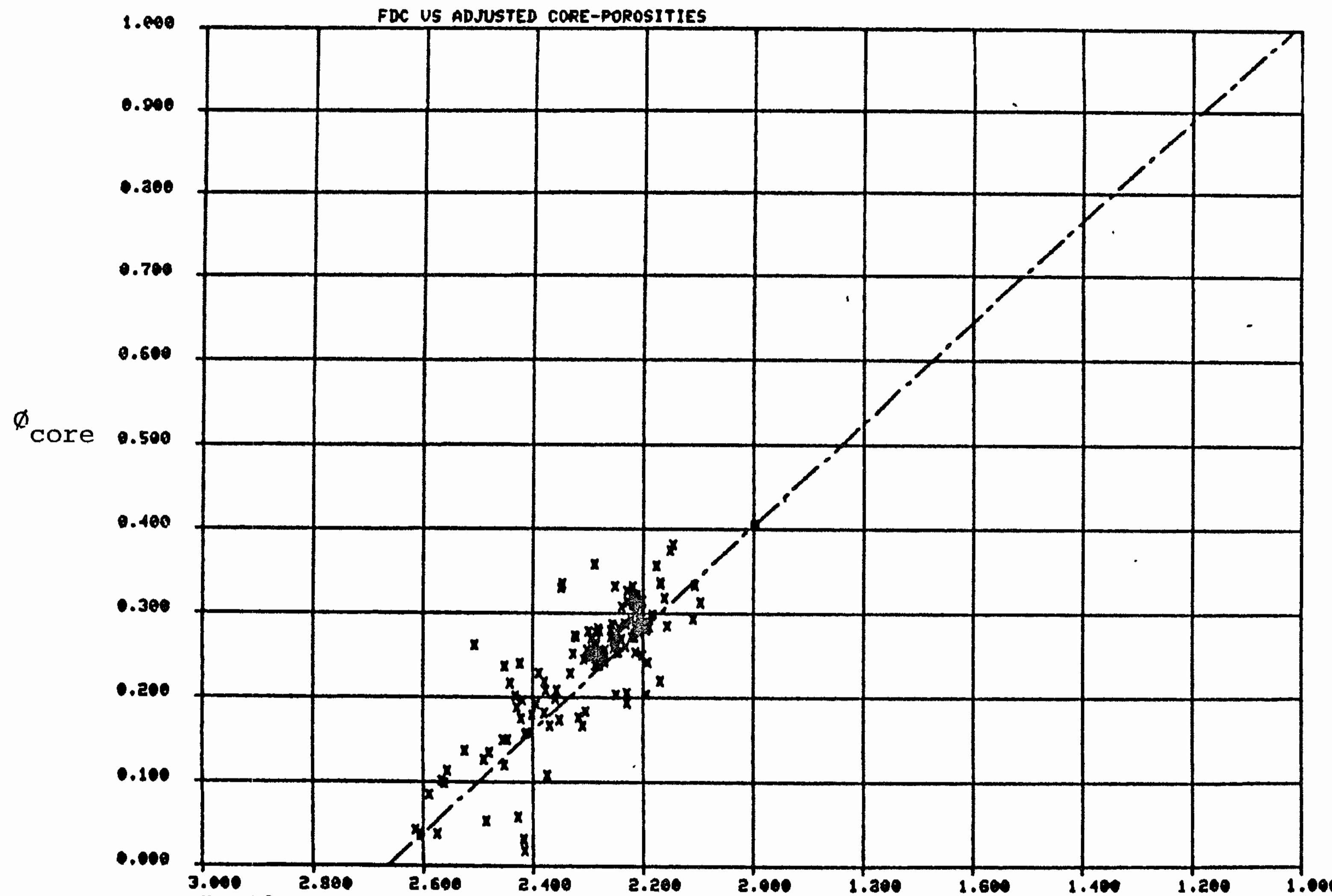

```
Y=A*X+B        A=    -0.61047254      B=     1.62108557
THE LINE INTERSECTS THE UPPER X-AXIS AT THE POINT     1.017
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT     2.655
OK?
YES

WELL   --              DEPTH:   1800.00   1900.00   TOTAL:   193   X.AV:   2.1693   Y.AV:   0.2878

  P L O T T E D   B Y :   HELGOY
```

Fig. 2

34/10-9 COOK

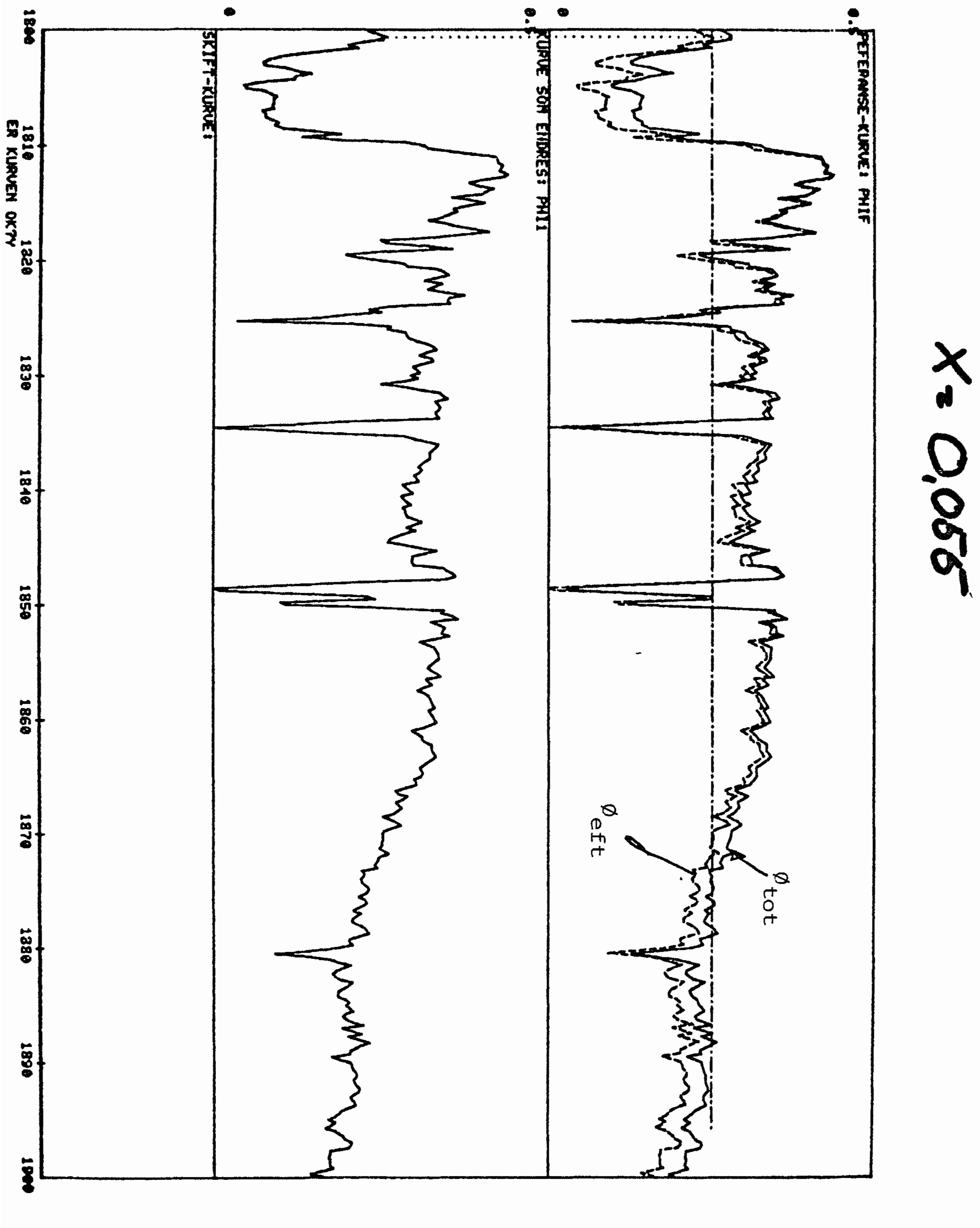


Y=AXX+B A= -0.60631328 B= 1.61611296
THE LINE INTERSECTS THE UPPER X-AXIS AT THE POINT 1.016
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT 2.665
OK?
YES

WELL 34-10-9 DEPTH: 2075.00 2175.00 TOTAL: 146 X.AV: 2.2946 Y.AV: 0.2435

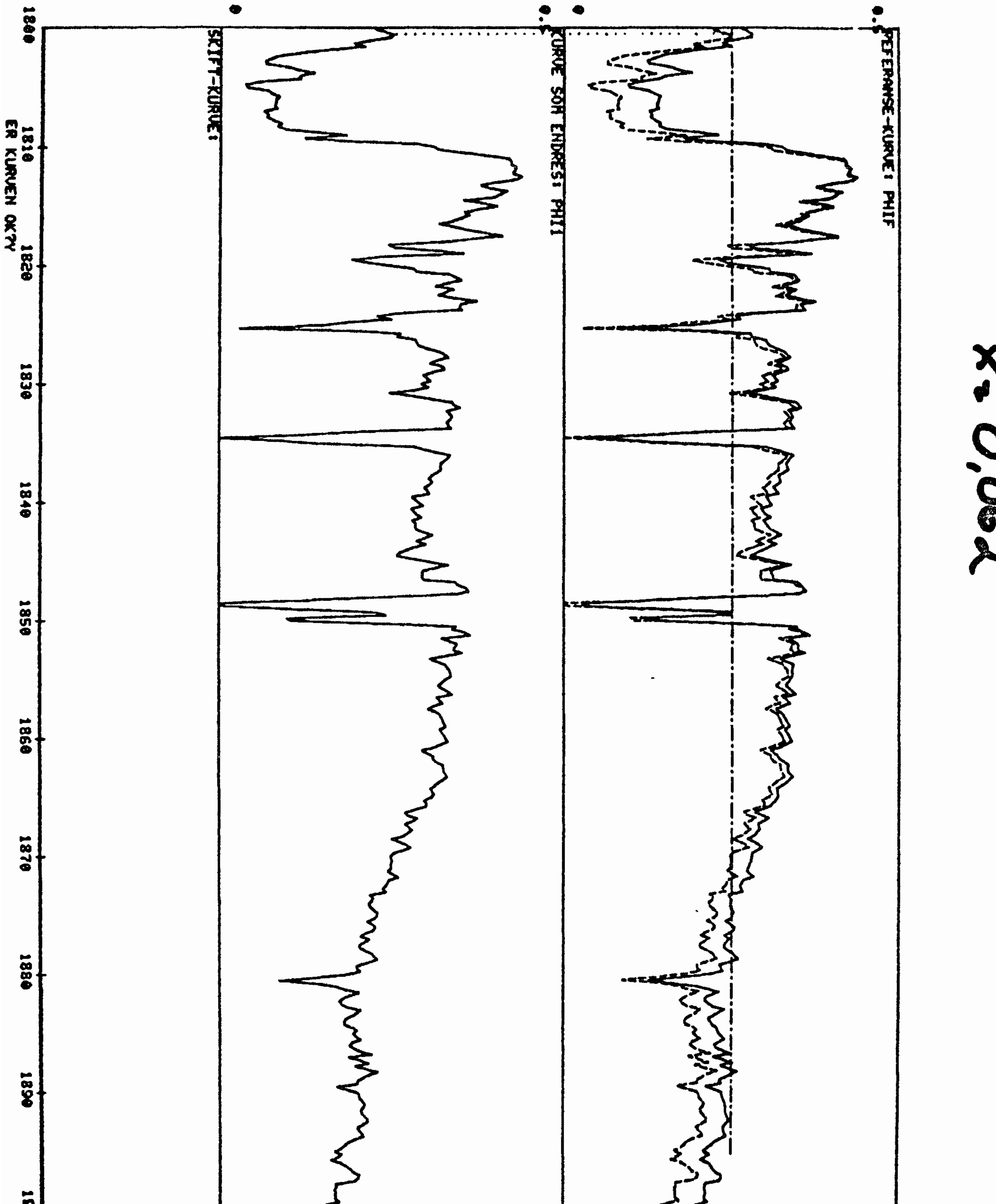
P L O T T E D B Y : HELGOY

Fig. 3



X = 0,055
REFERANSE-KURVE: PHIF
KURVE SOM ENDRES: PHII
SKIFT-KURVE:
ER KURVEN OK?Y
Ø tot
Ø eft
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900

Fig. 4



REFERANSE-KURVE: PHIF
KURVE SOM ENDRES: PHII
SKIFT-KURVE:
ER KURVEN OK?Y
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
X = 0,062

Fig. 5

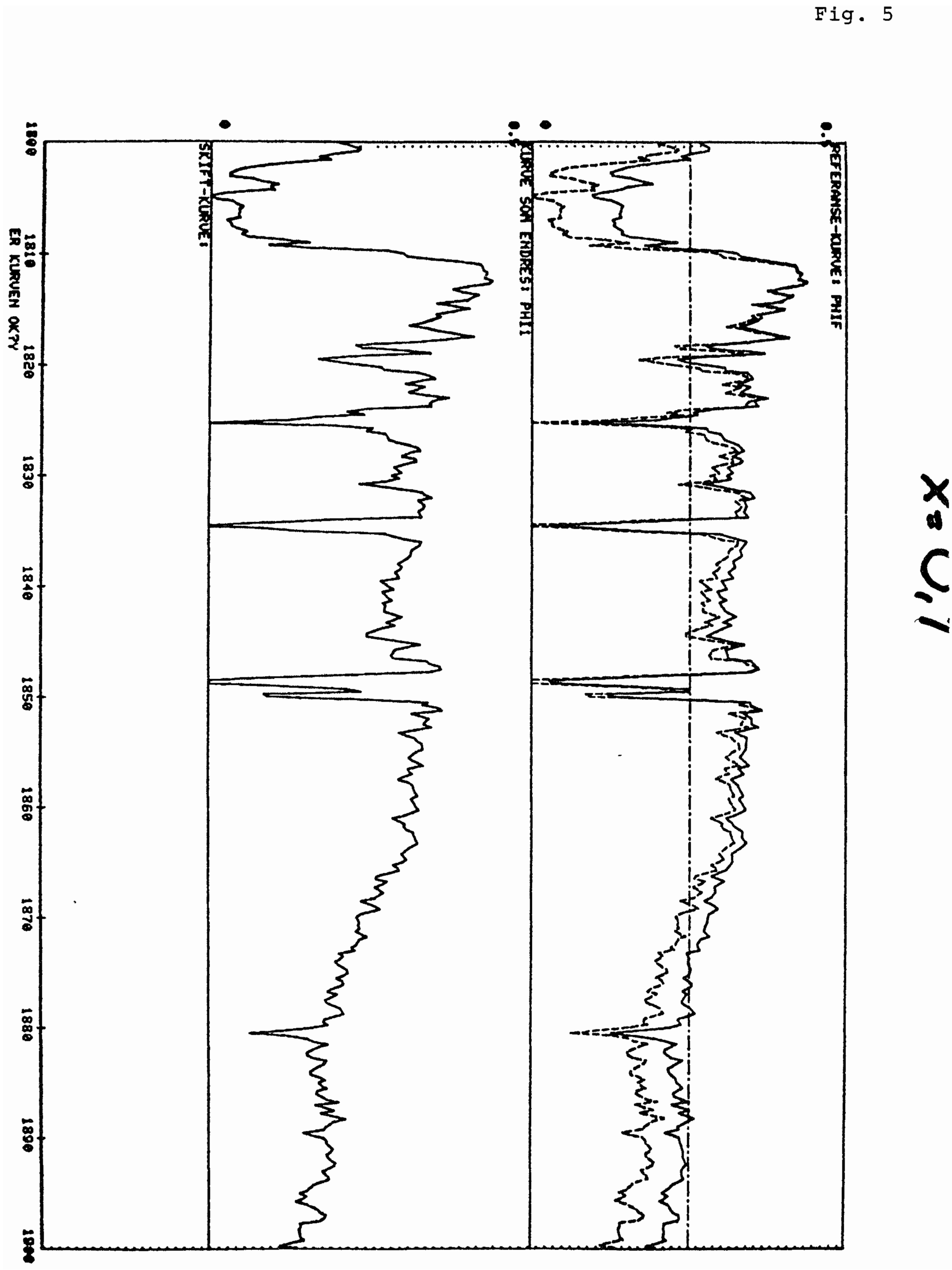
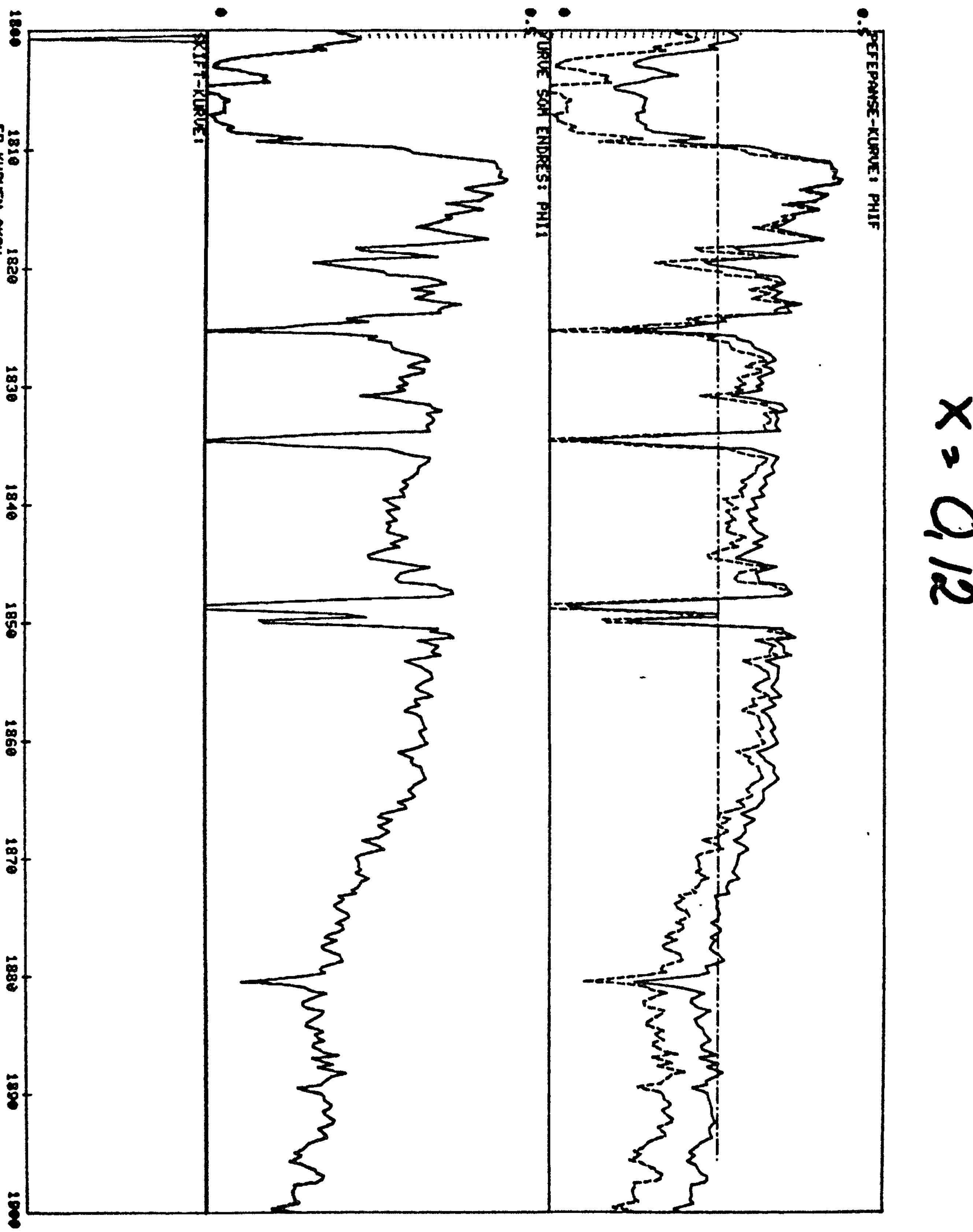
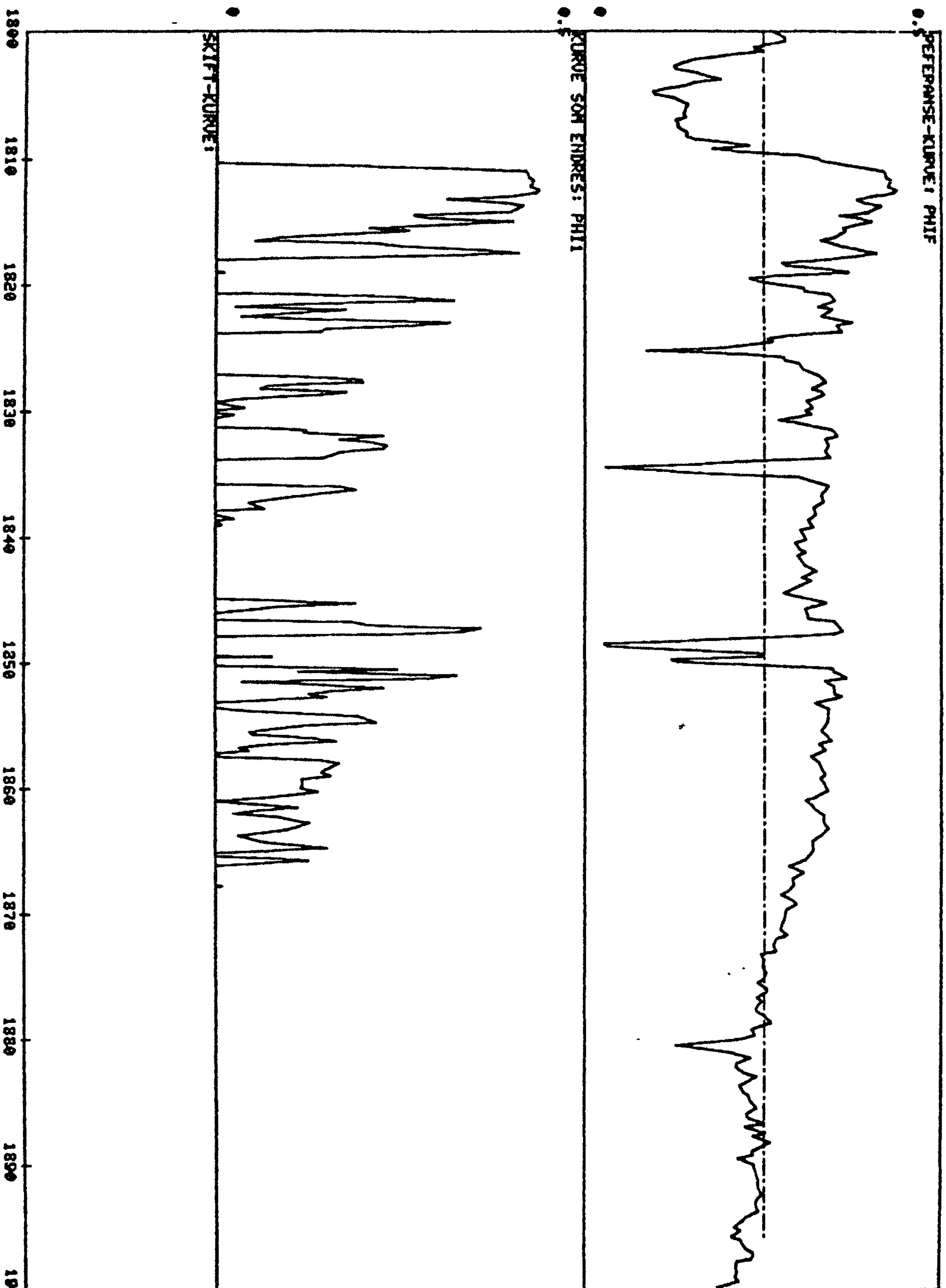

REFERANSE-KURVE: PHIF
KURVE SOM ENDRES: PHII
SKIFT-KURVE:
ER KURVEN OK?Y
0.5
0
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
X = 0,7

Fig. 6



REFERANSE-KURVE: PHIF
KURVE SOM ENDRES: PHI1
SKIFT-KURVE:
ER KURVEN OK?
0.5
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
x = 0,12

Fig. 7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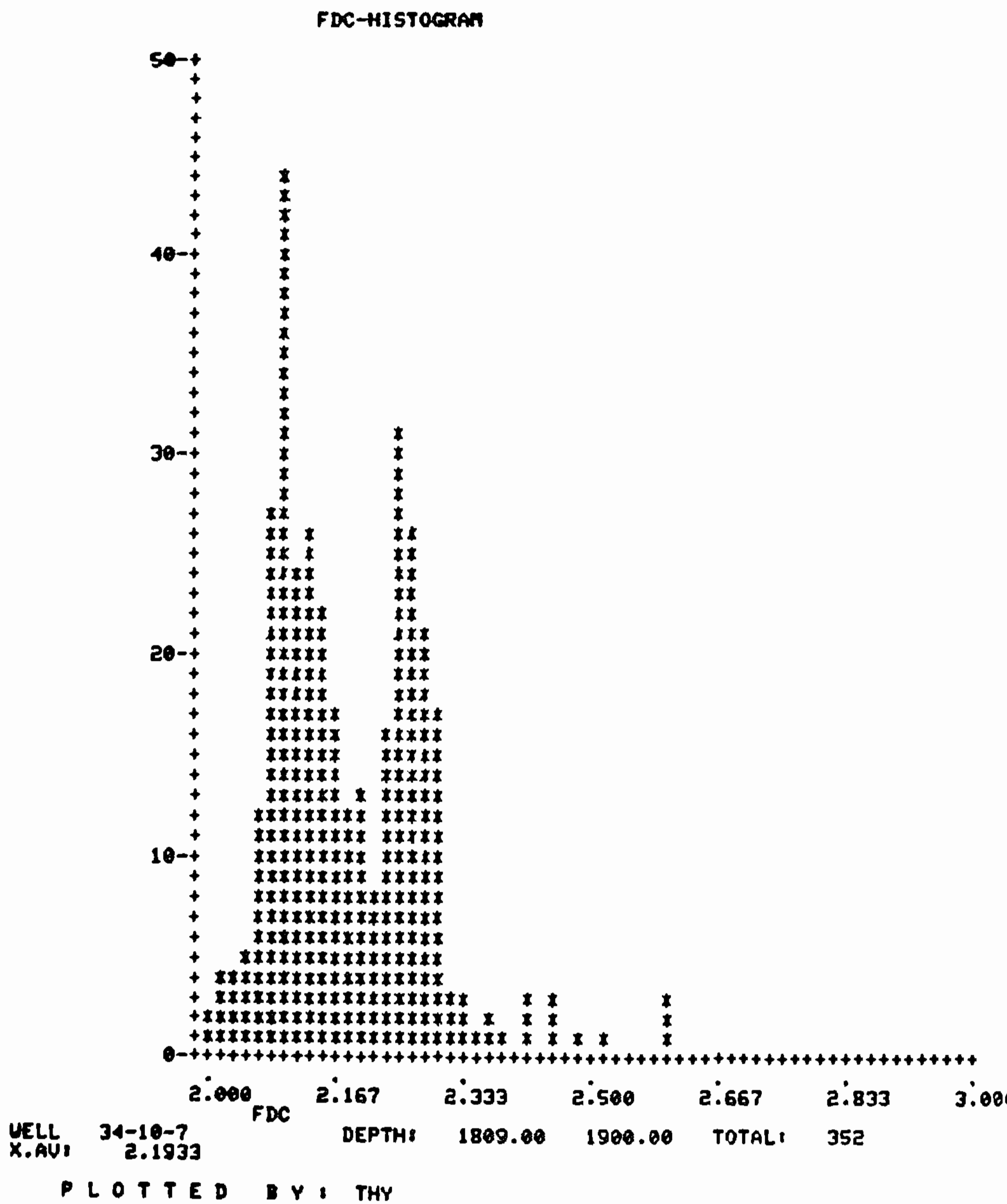
KURVE SOM ENDRES: PHII
SKIFT-KURVE:
0.5
0.5
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900

X = 0,13

Fig. 8

34/10-7 COOK



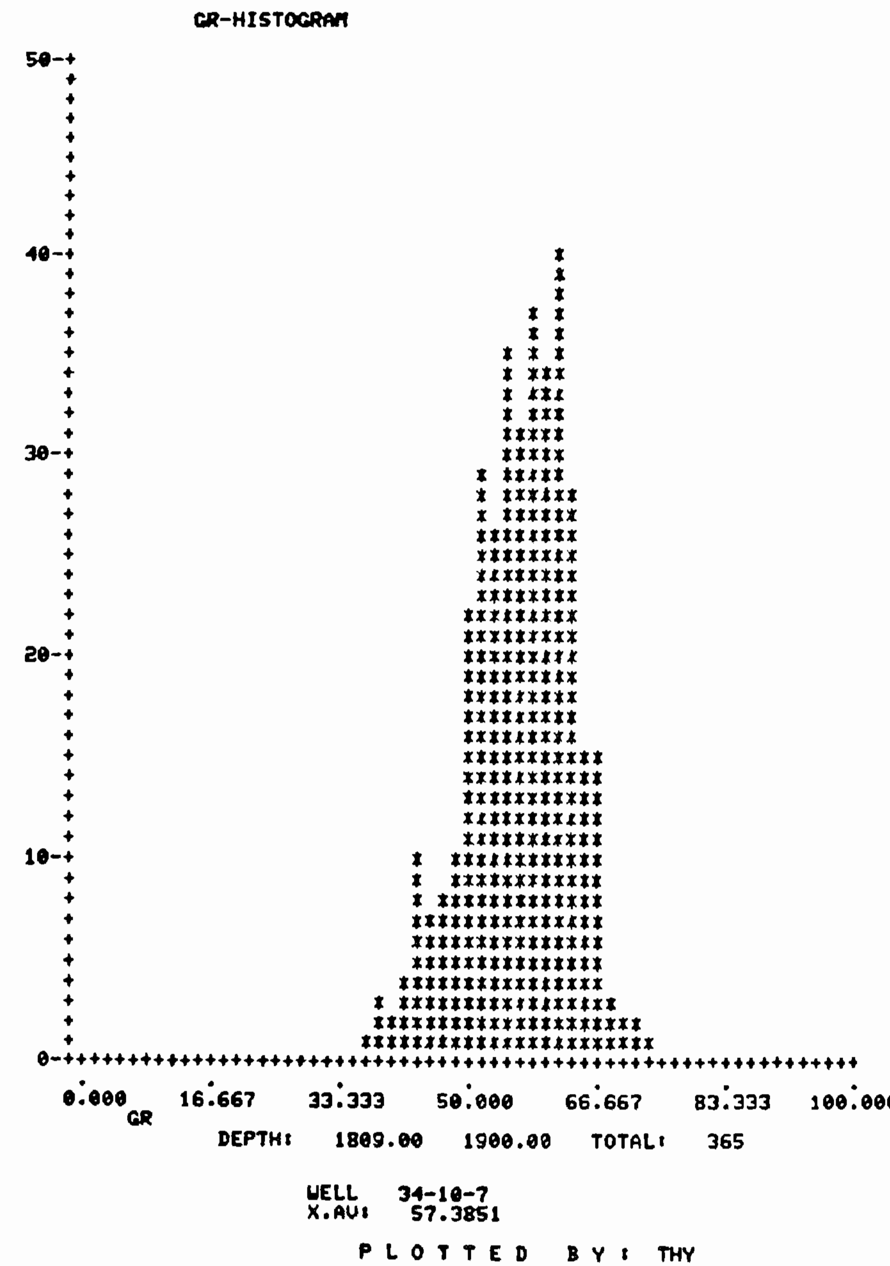


Fig. 9

34/10-7 COOK

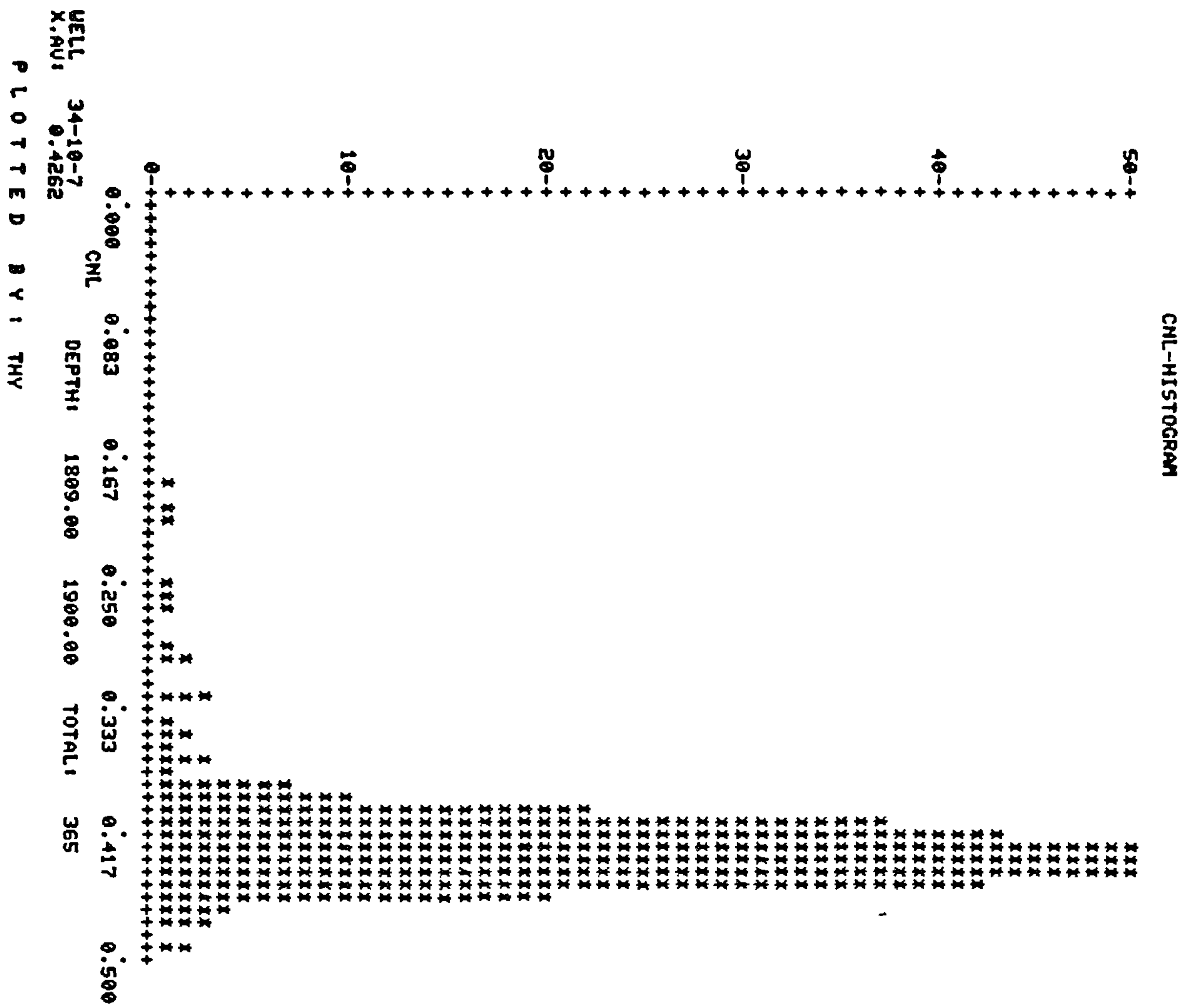
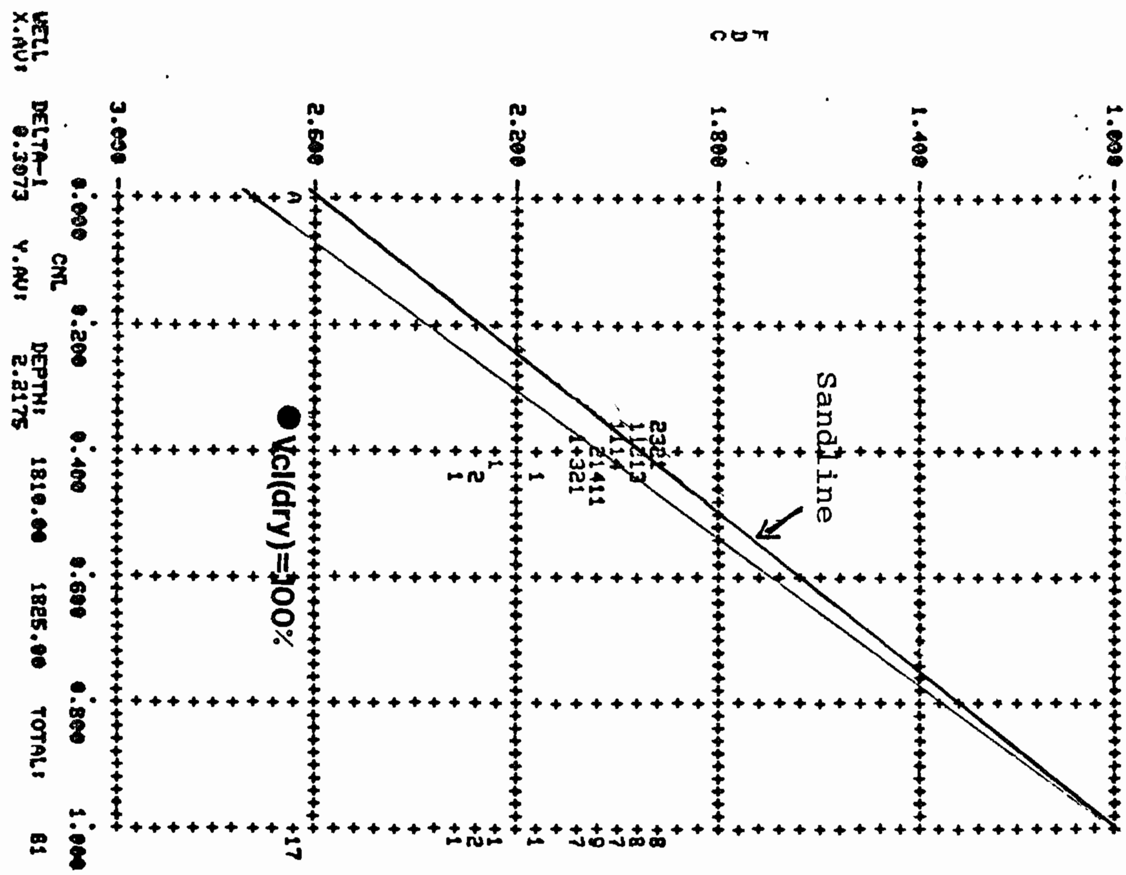


Fig. 10

34/10-7 COOK - 3



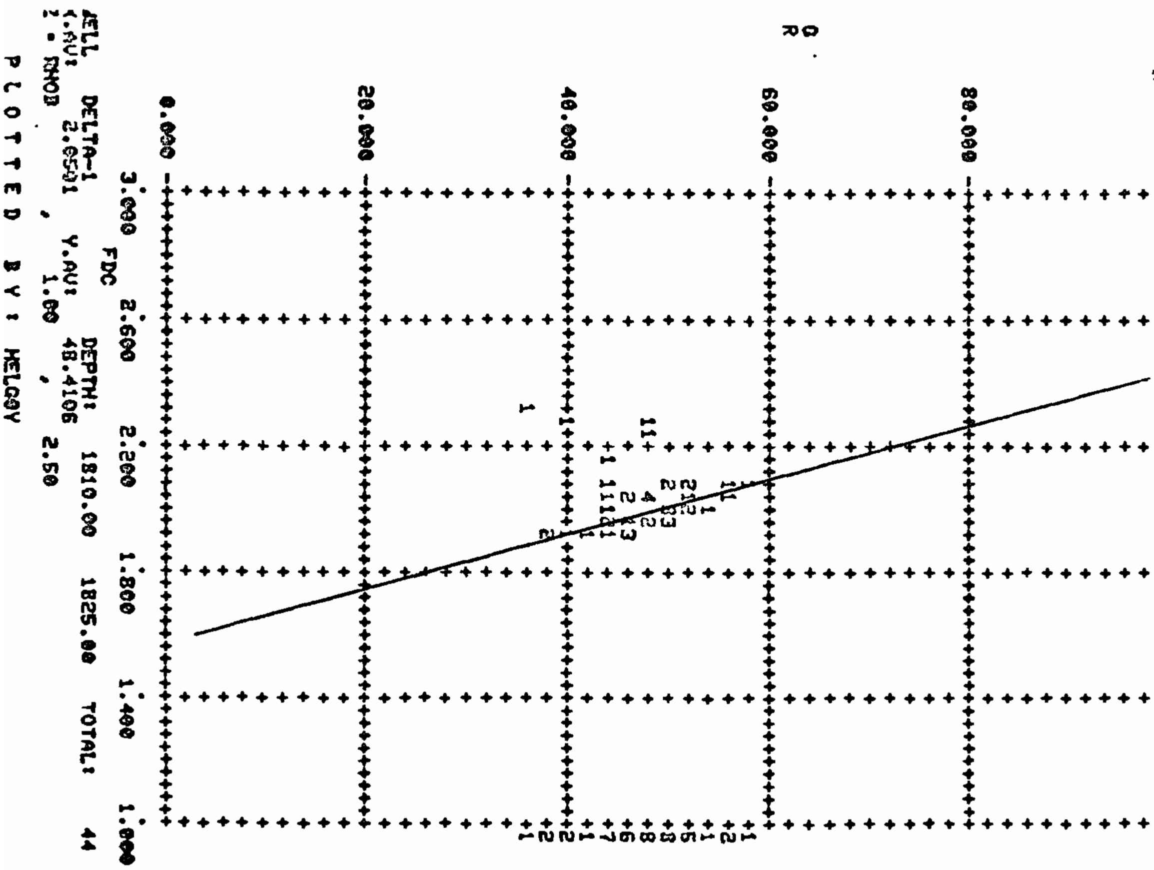
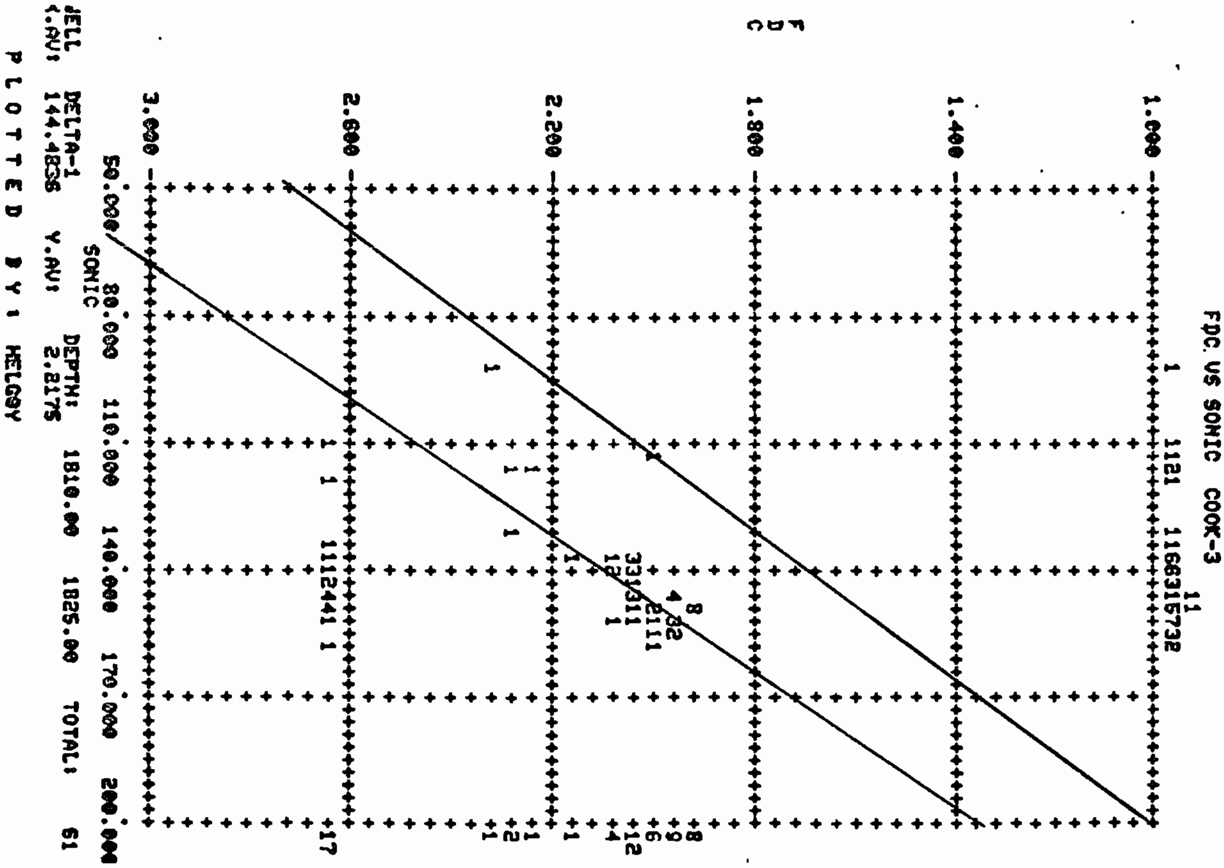


Fig. 11

34/10-7 COOK 3



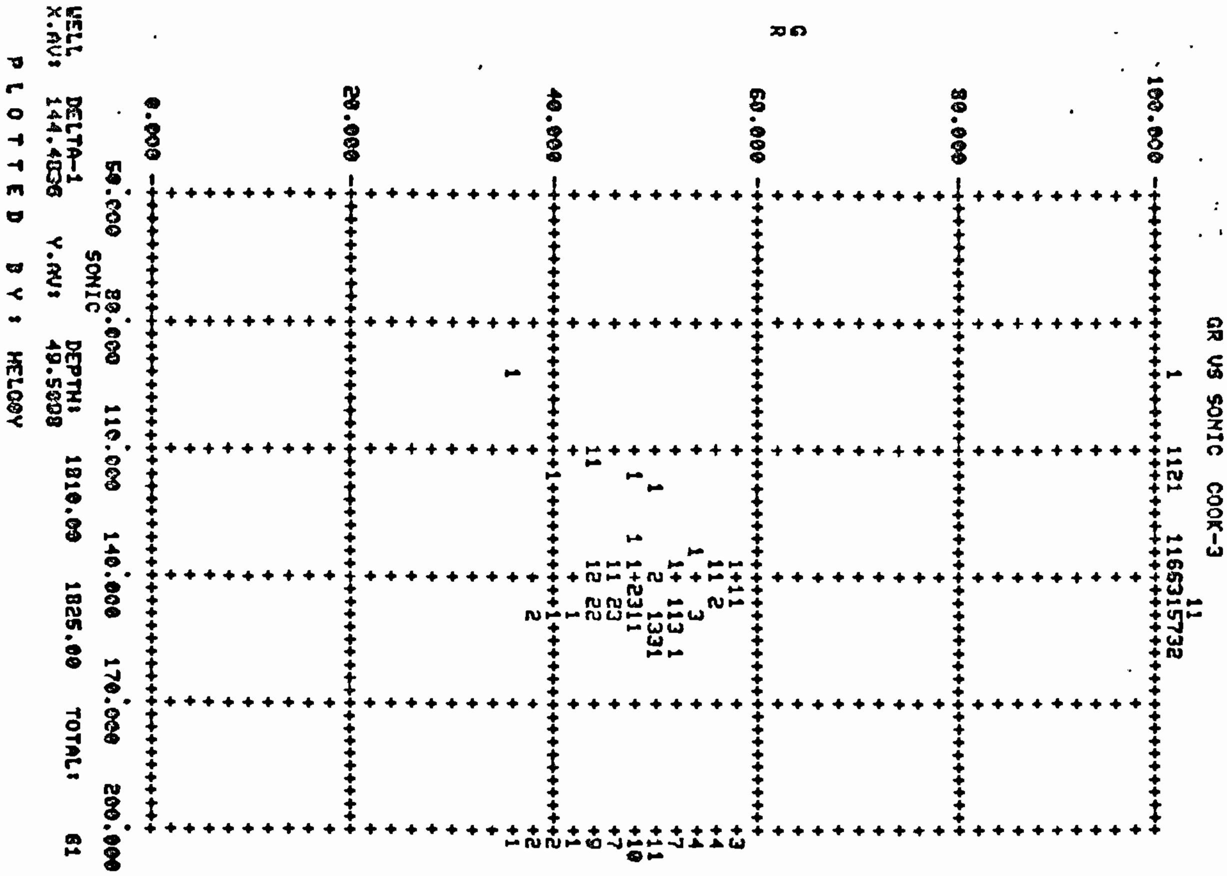
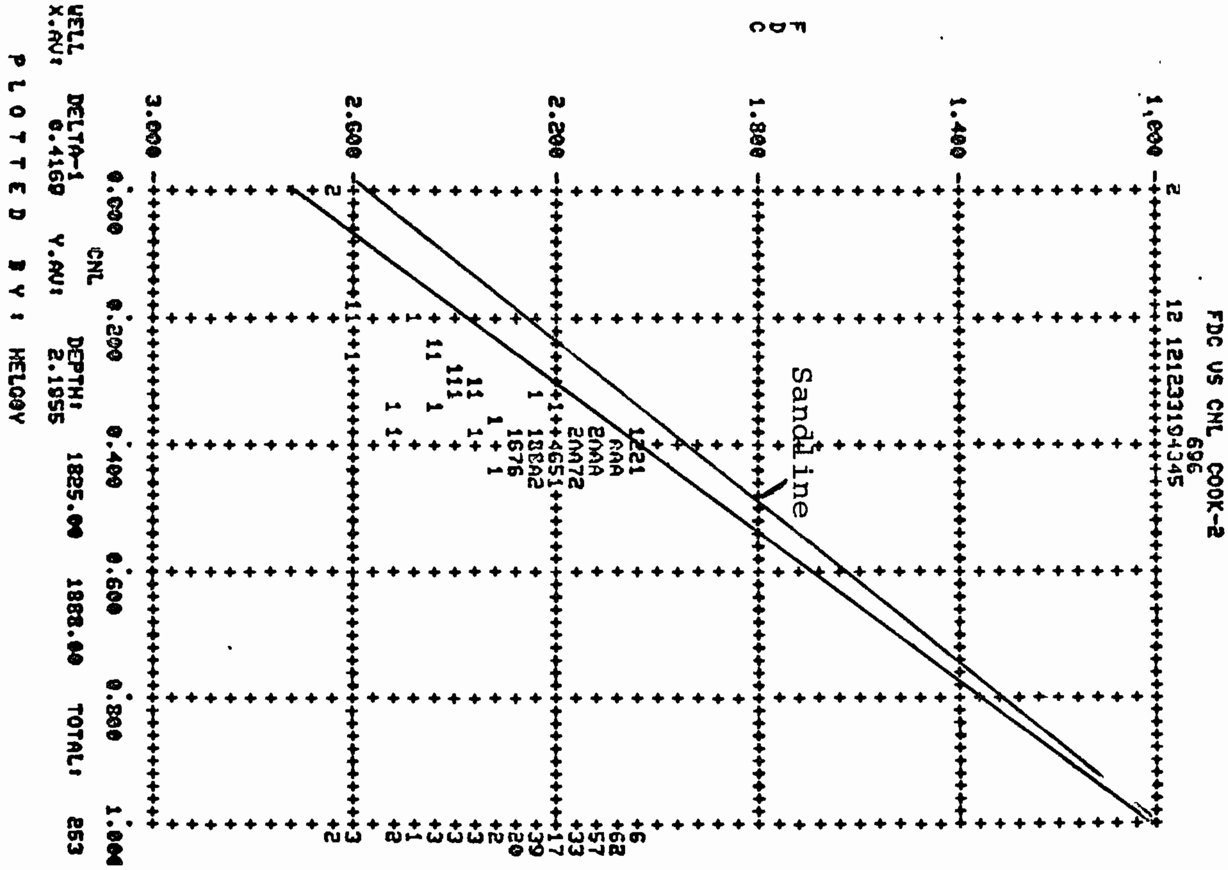


Fig. 12

34/10-7 COOK 2



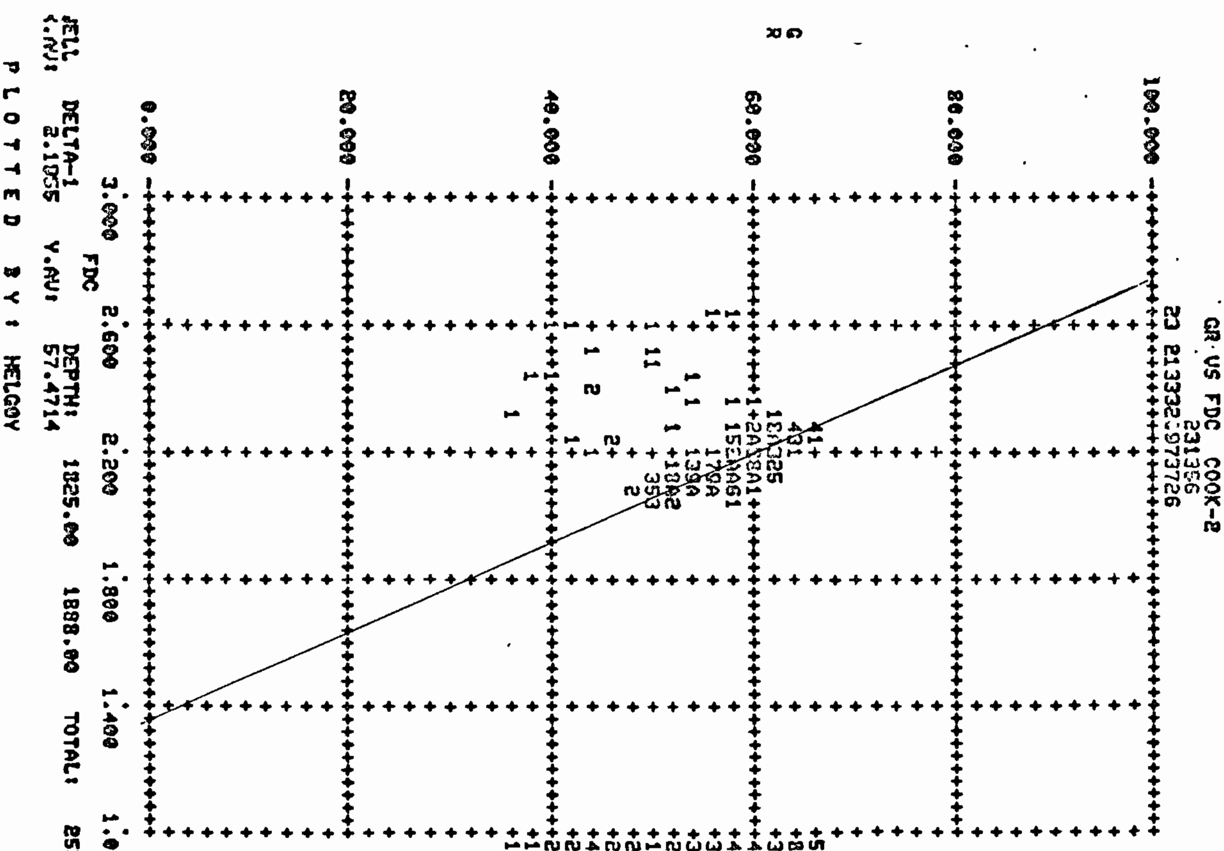
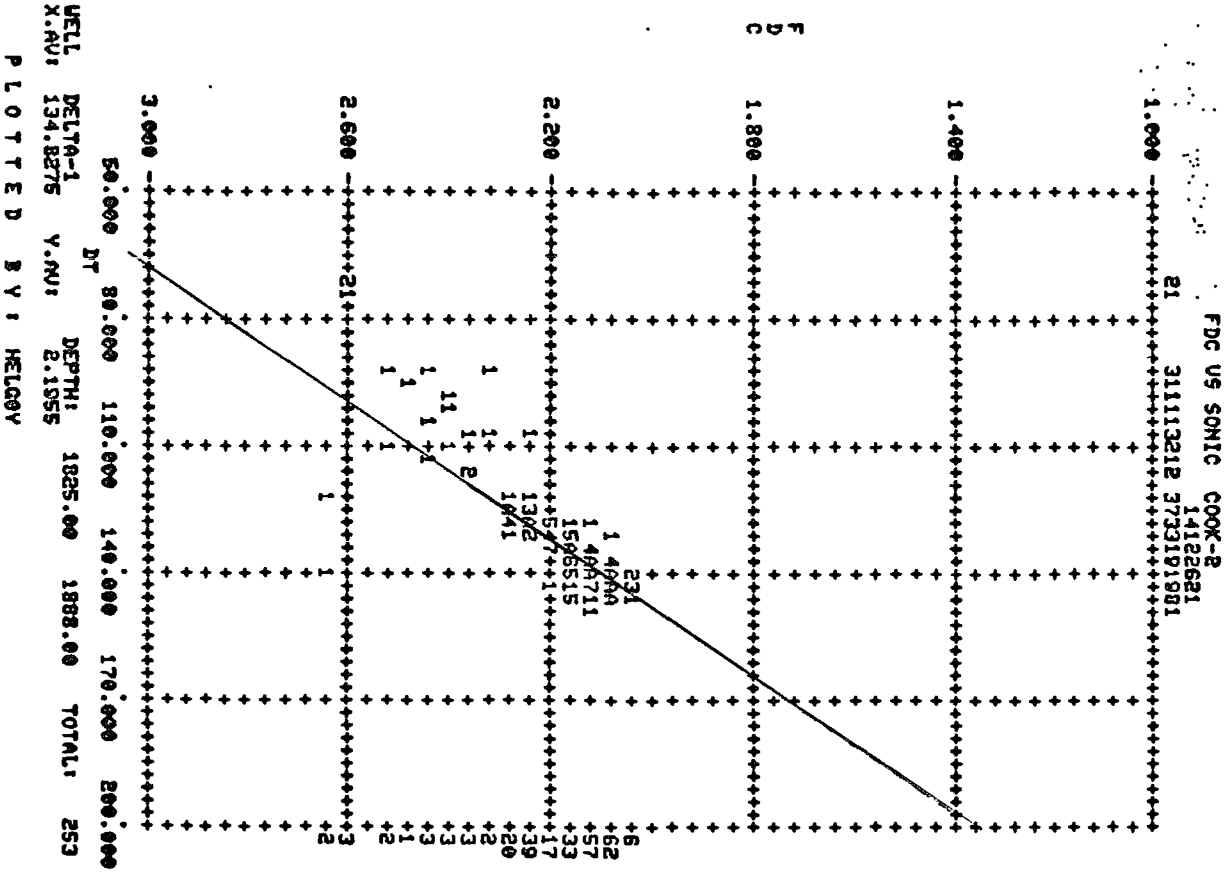


Fig. 13

34/10-7 COOK 2



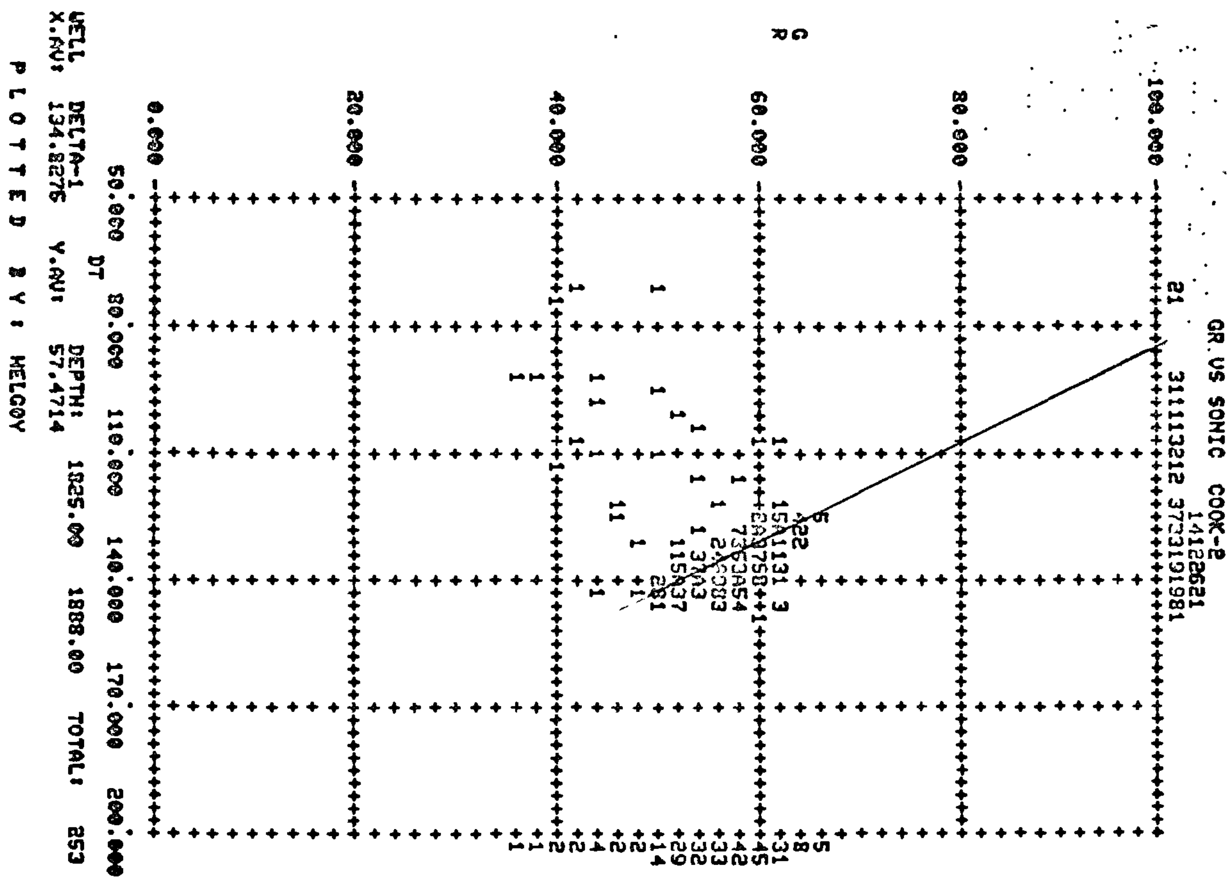
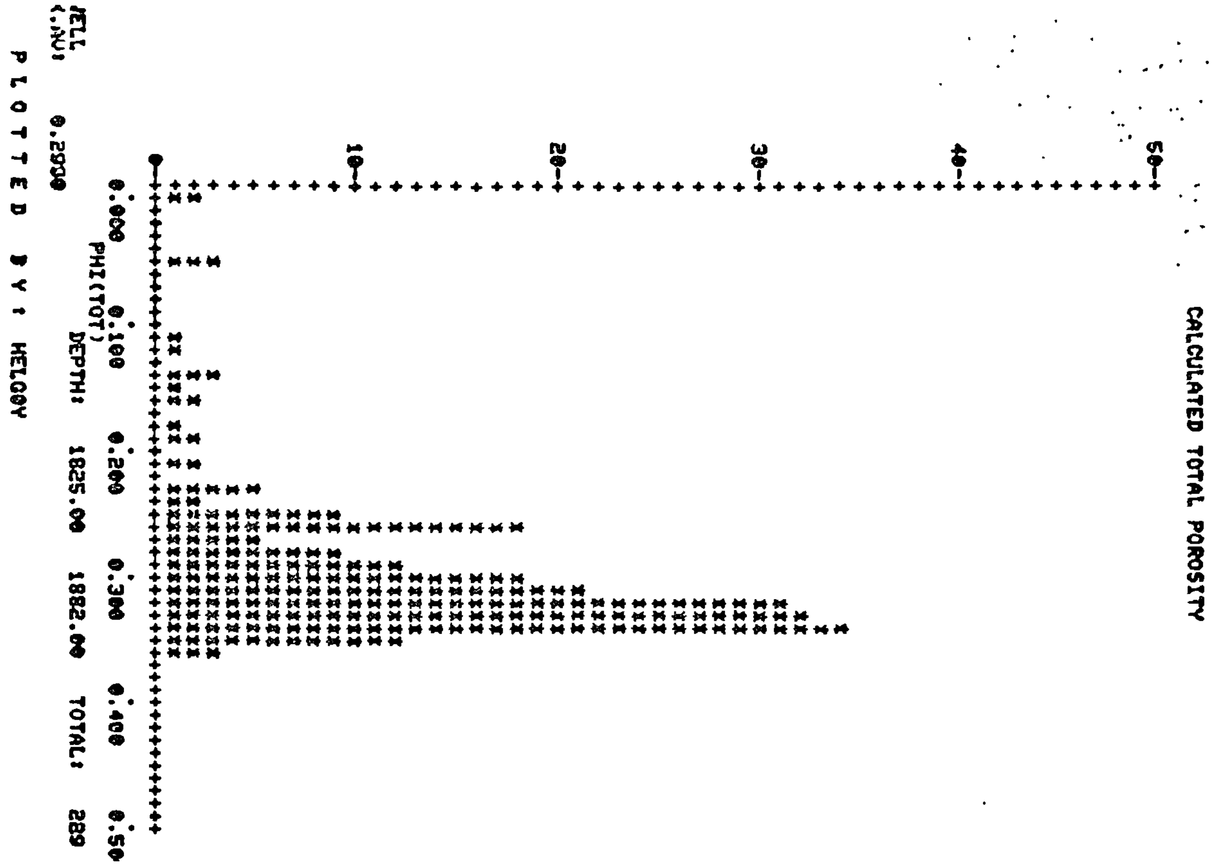


Fig. 14

COOK-2 34-10-7



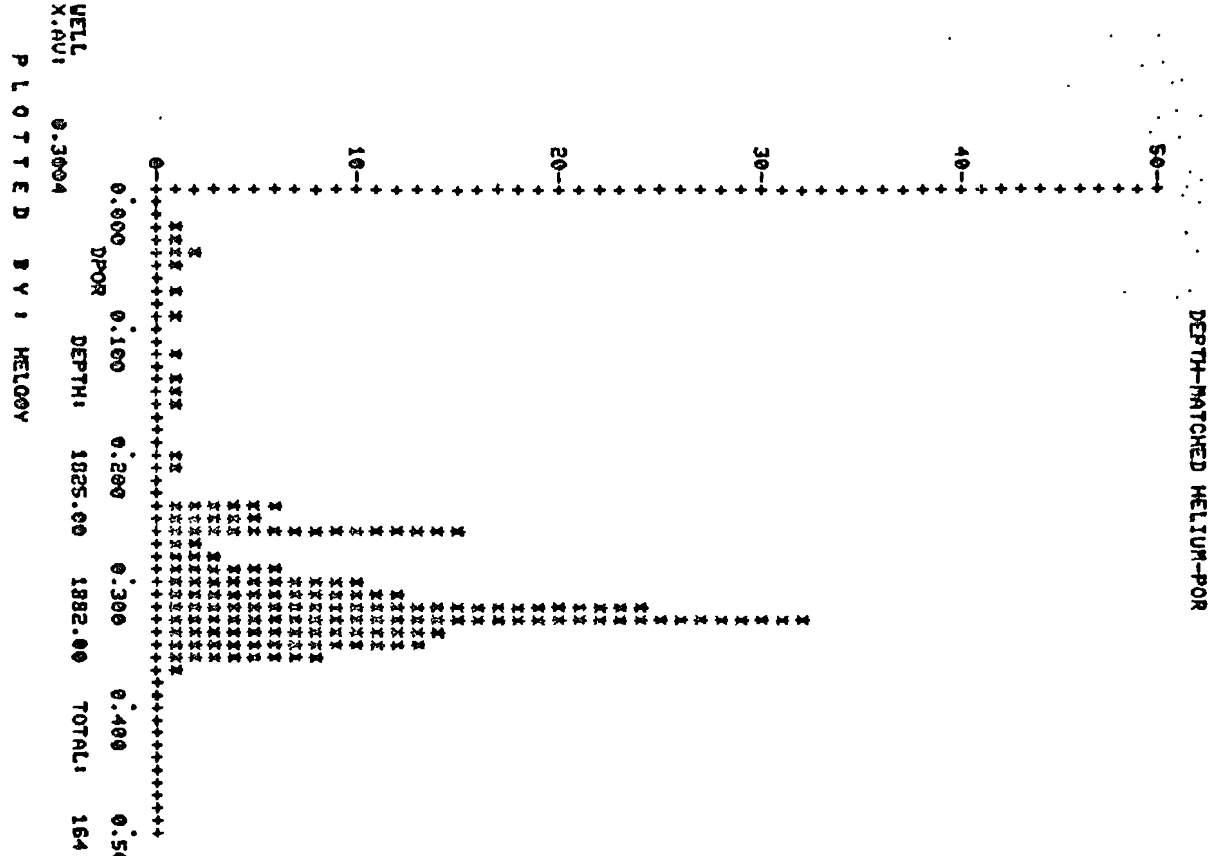
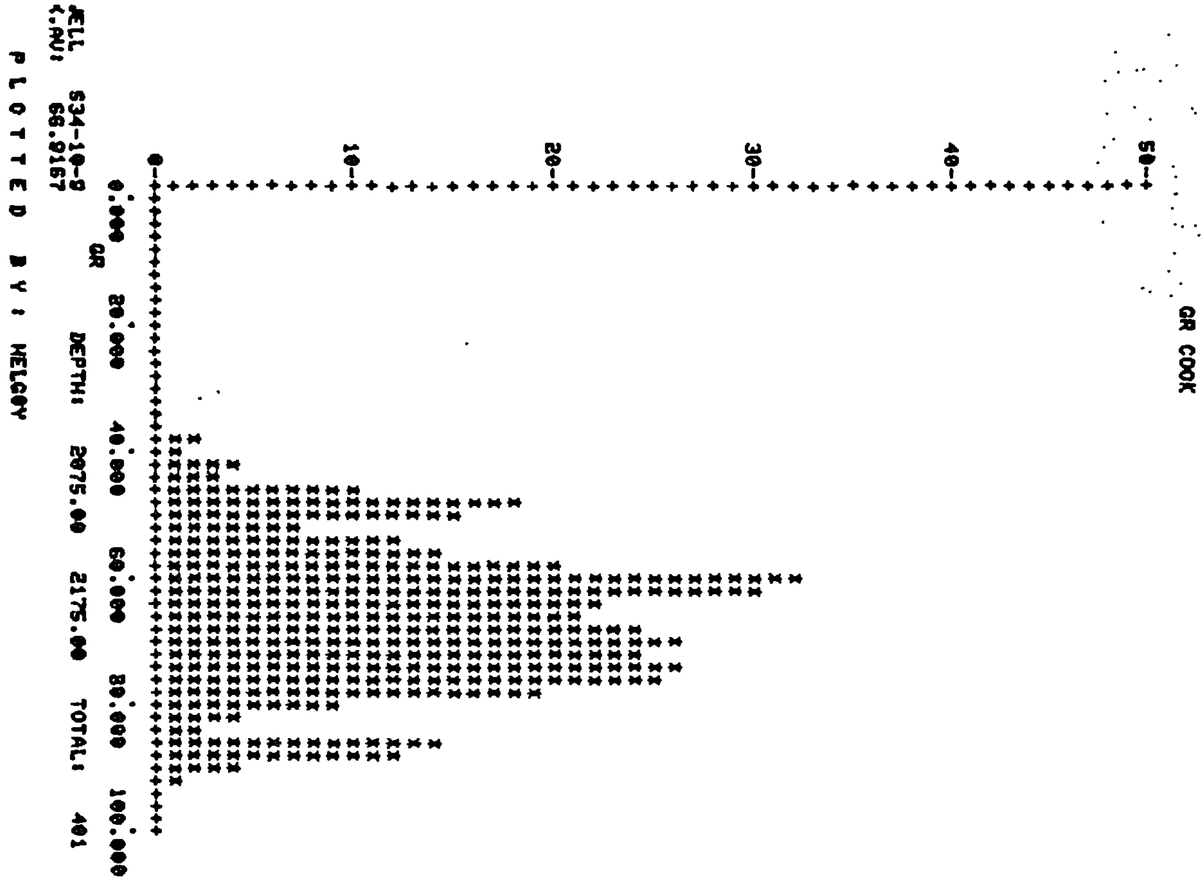


Fig. 15


GR COOK
0
10
20
30
40
50
0.000
20.000
40.000
60.000
80.000
100.000
GR
WELL S34-10-9
DEPTH: 2075.00 2175.00 TOTAL: 401
PLOTTED BY: HELGOY

34/10-9

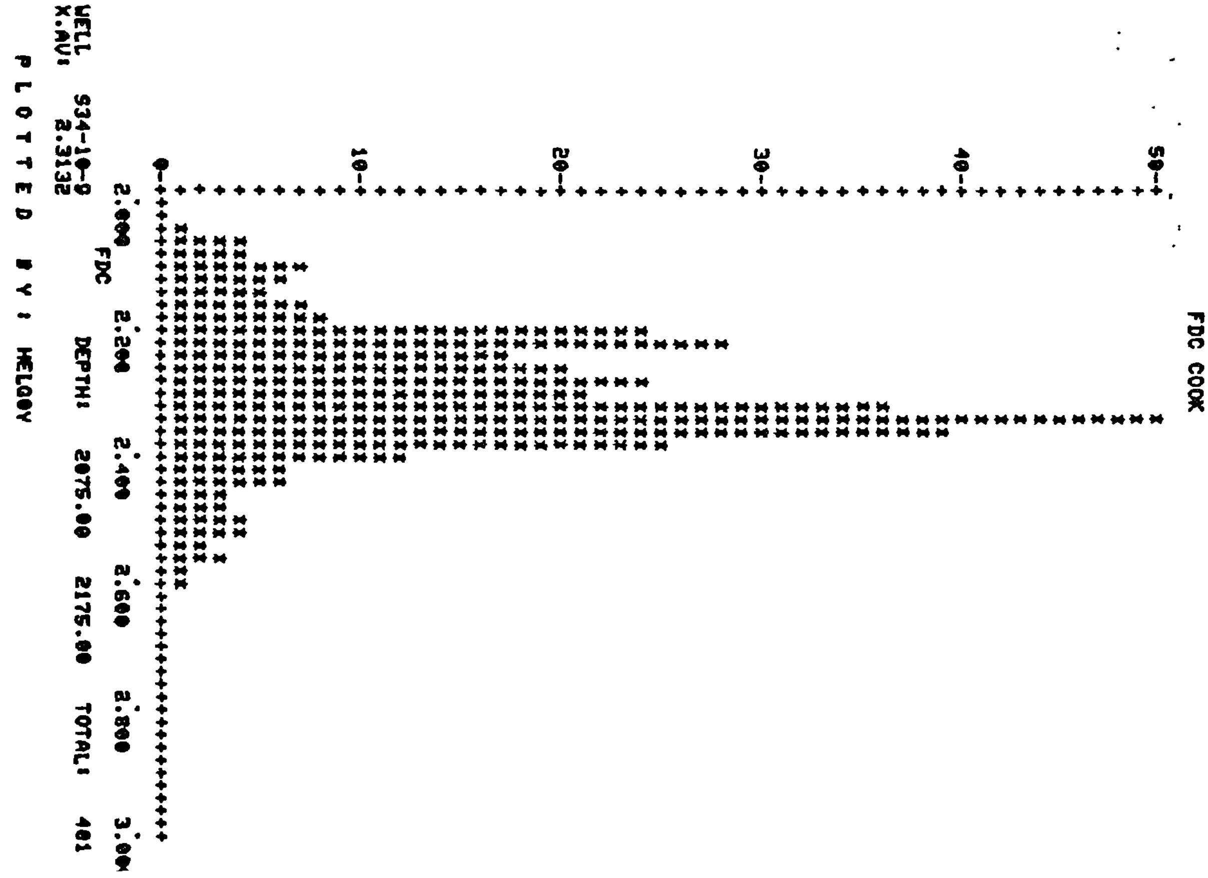

FDC COOK
0
10
20
30
40
50
2.000
2.200
2.400
2.600
2.800
3.000
FDC
WELL S34-10-9
X.AU: 2.3132
DEPTH: 2075.00 2175.00 TOTAL: 401
PLOTTED BY: HELGOY

Fig. 16

34/10-9

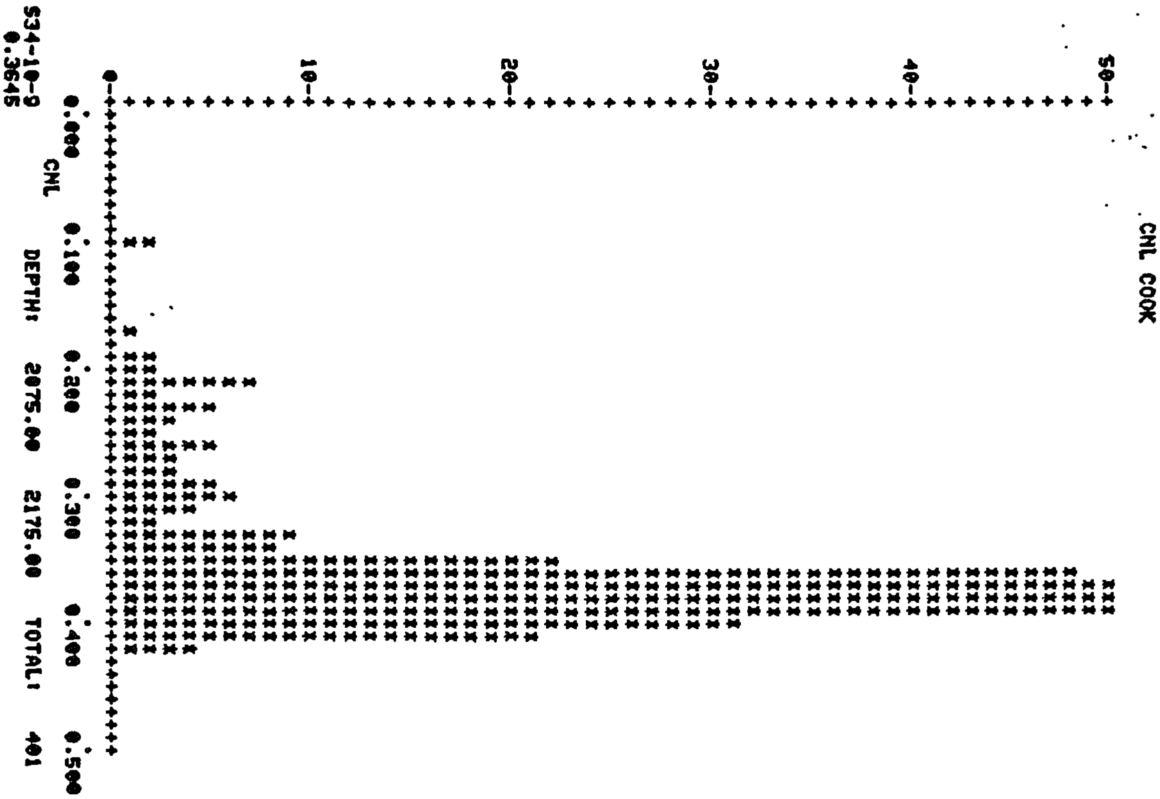
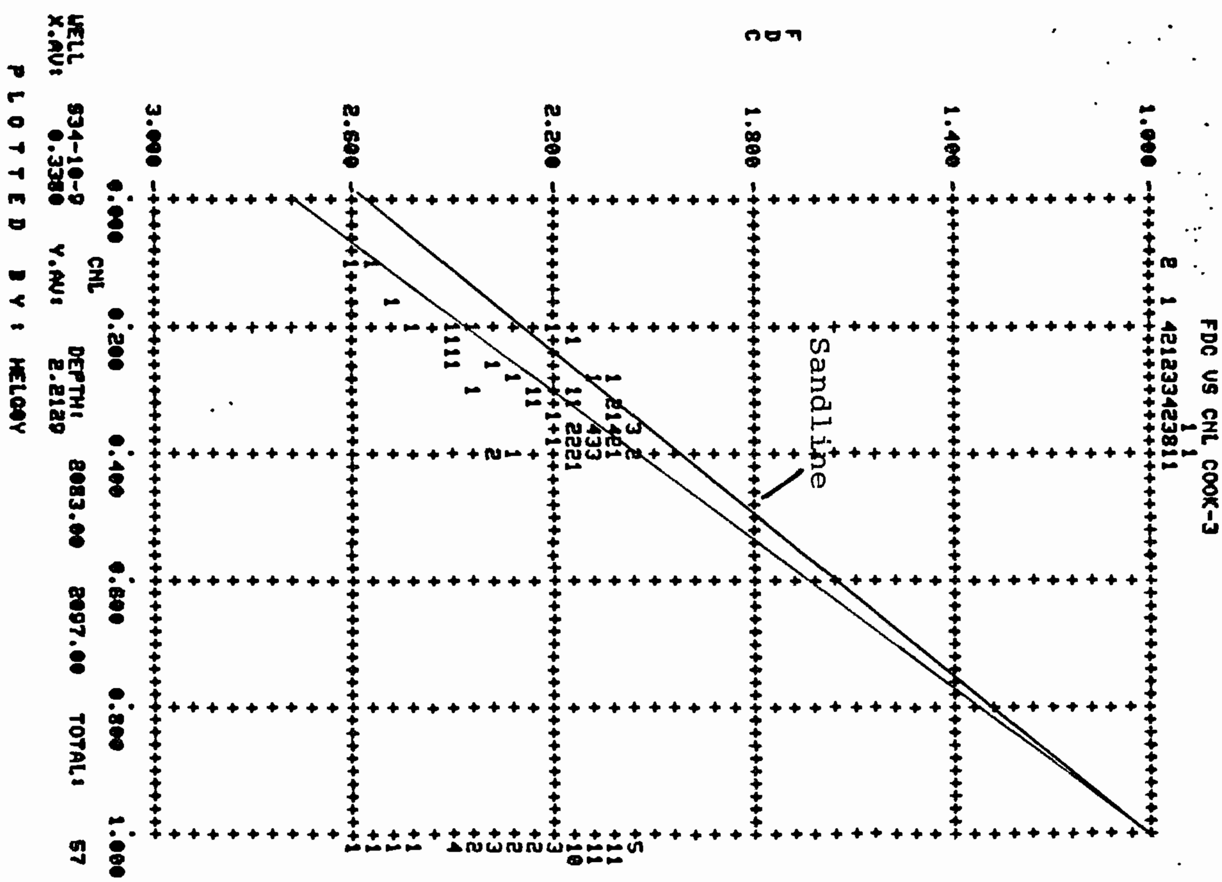

CNL COOK
WELL S34-10-9
X.AV: 0.3645
CNL
DEPTH: 2075.00 2175.00
TOTAL: 401
0.000
0.100
0.200
0.300
0.400
0.500
0
10
20
30
40
50

Fig. 17

34/10-9 COOK 3



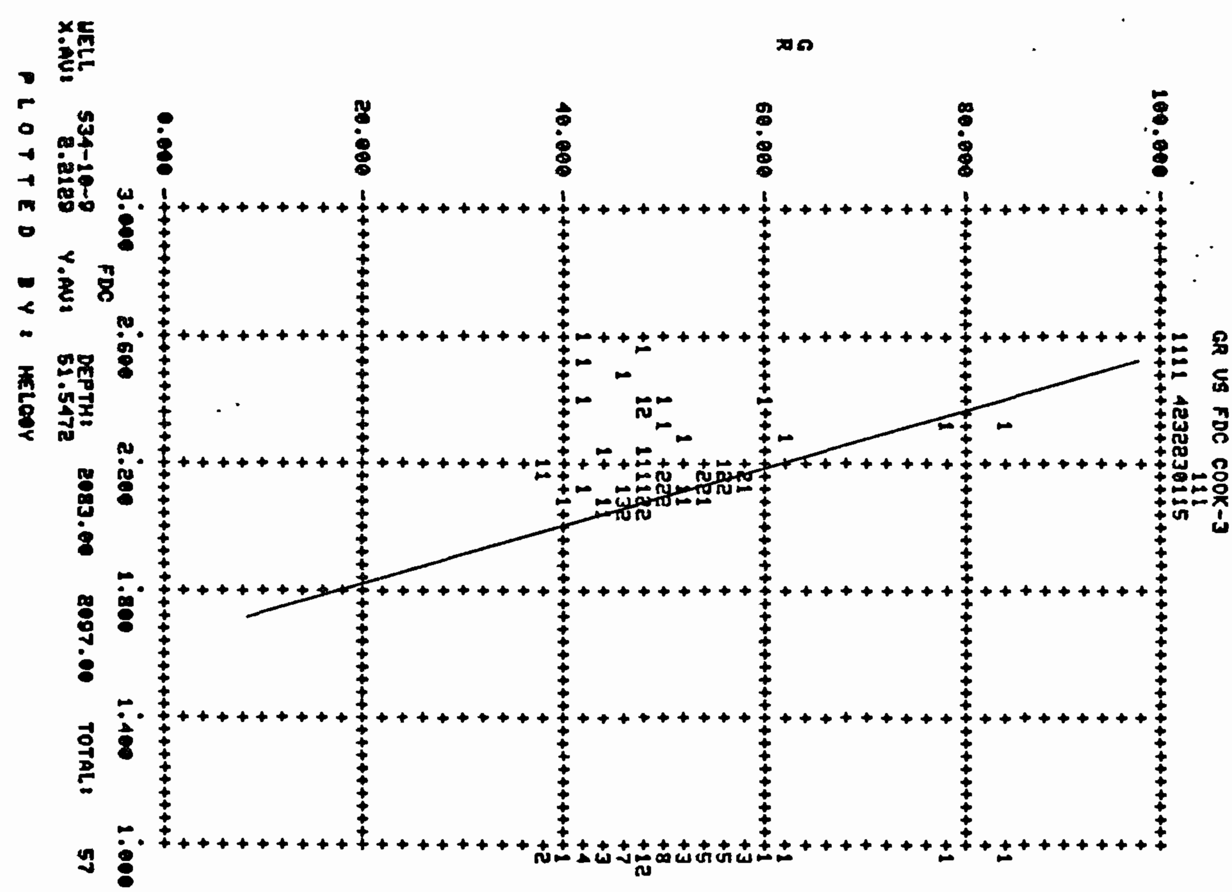
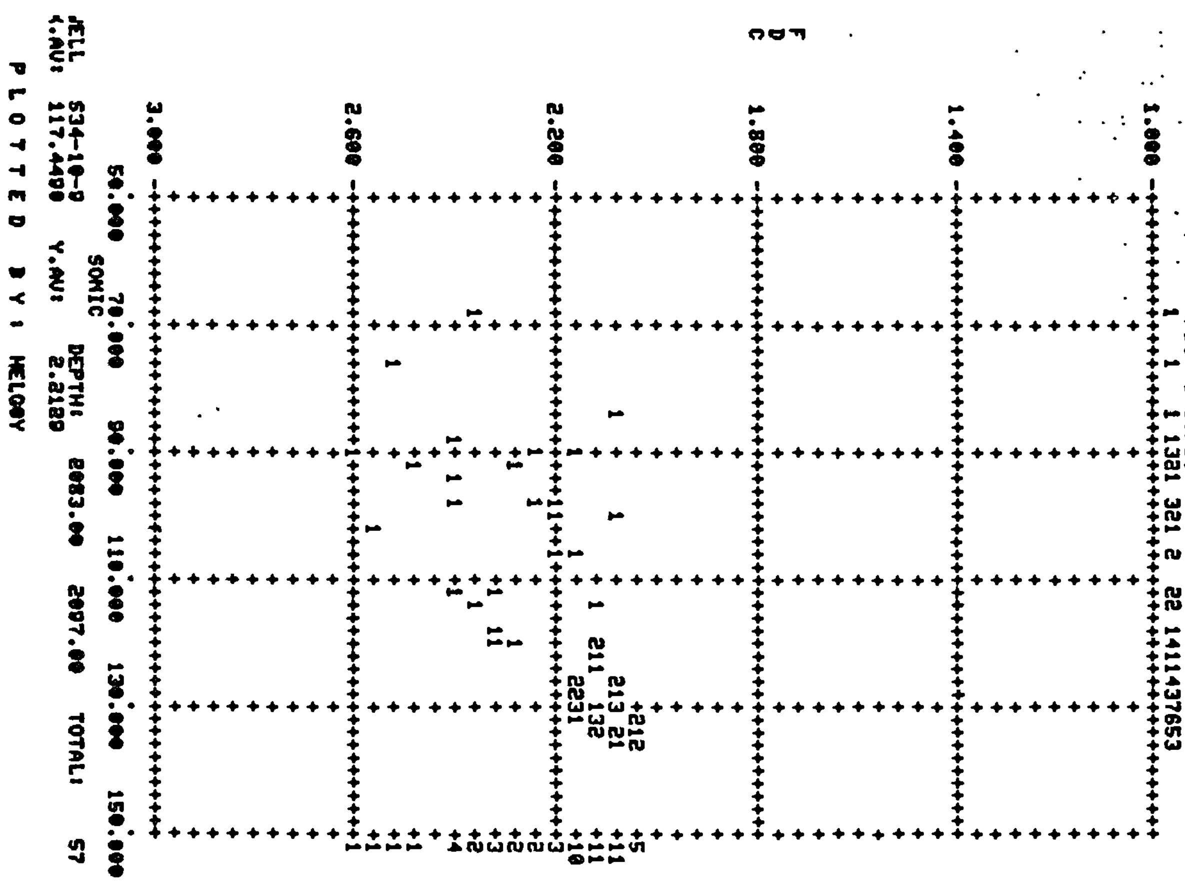


Fig. 18

34/10-9 COOK 3



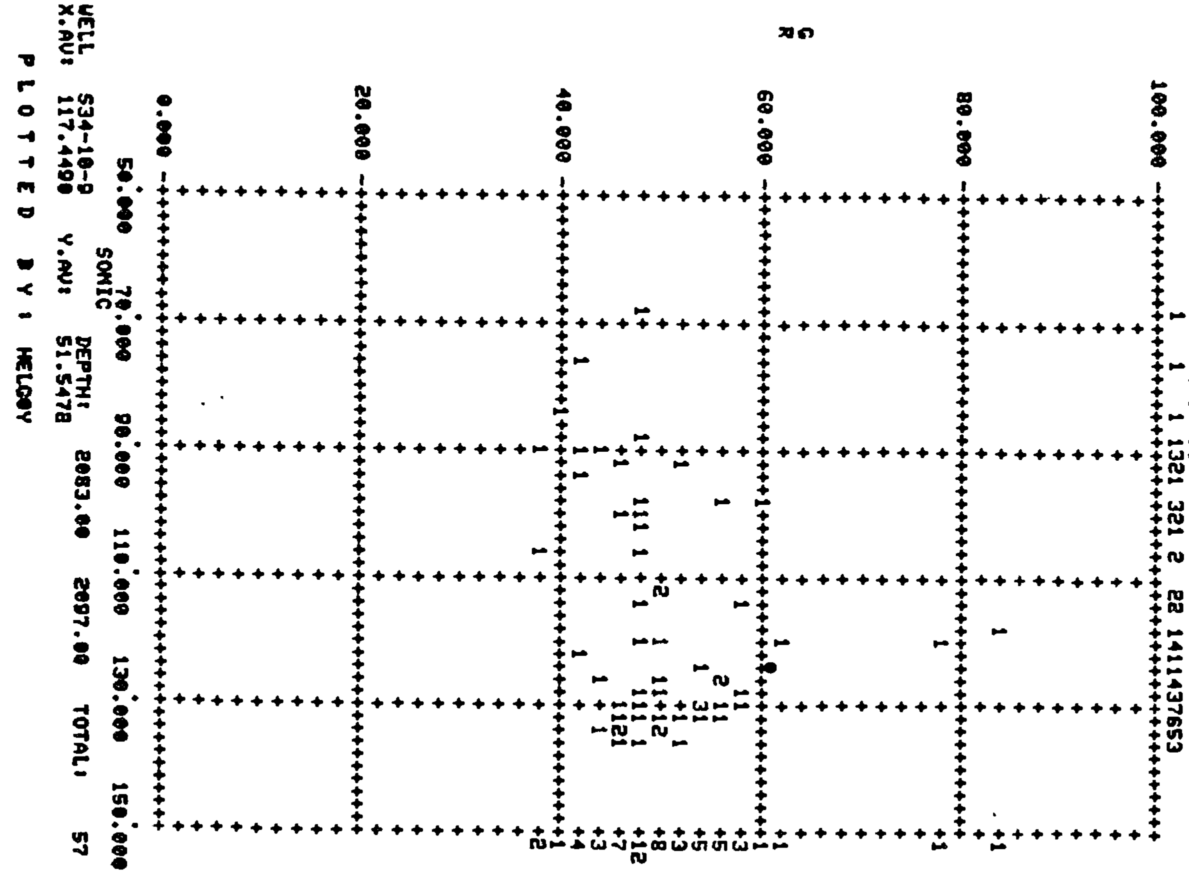
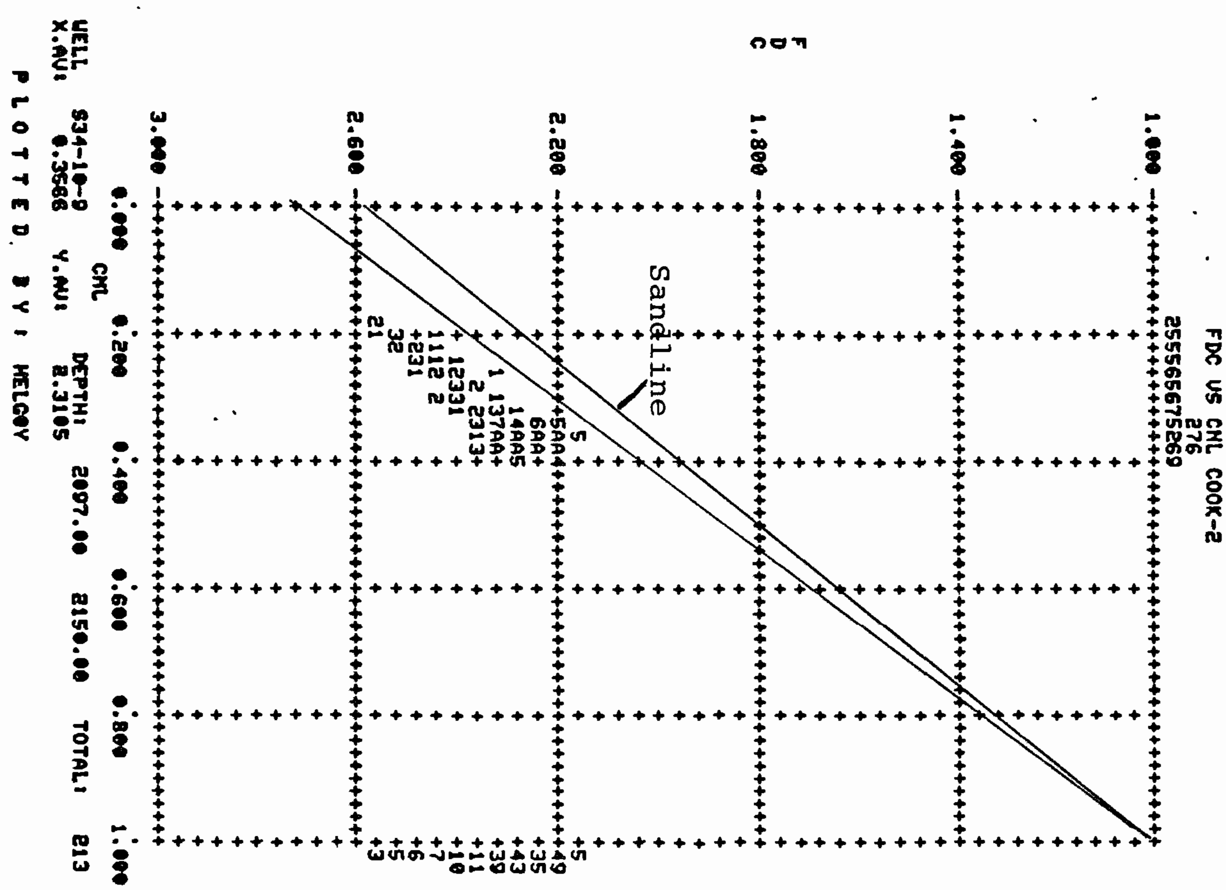


Fig. 19

34/10-9 COOK - 2



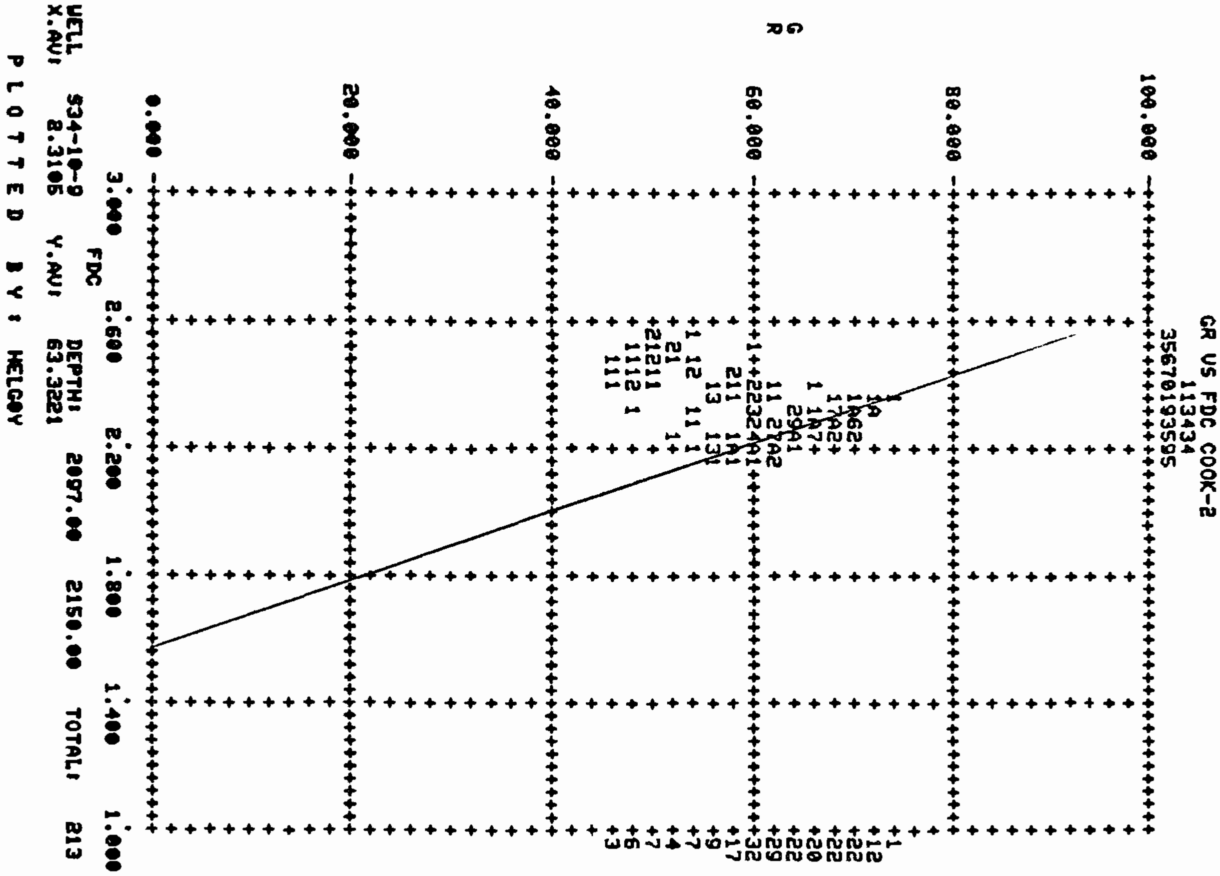
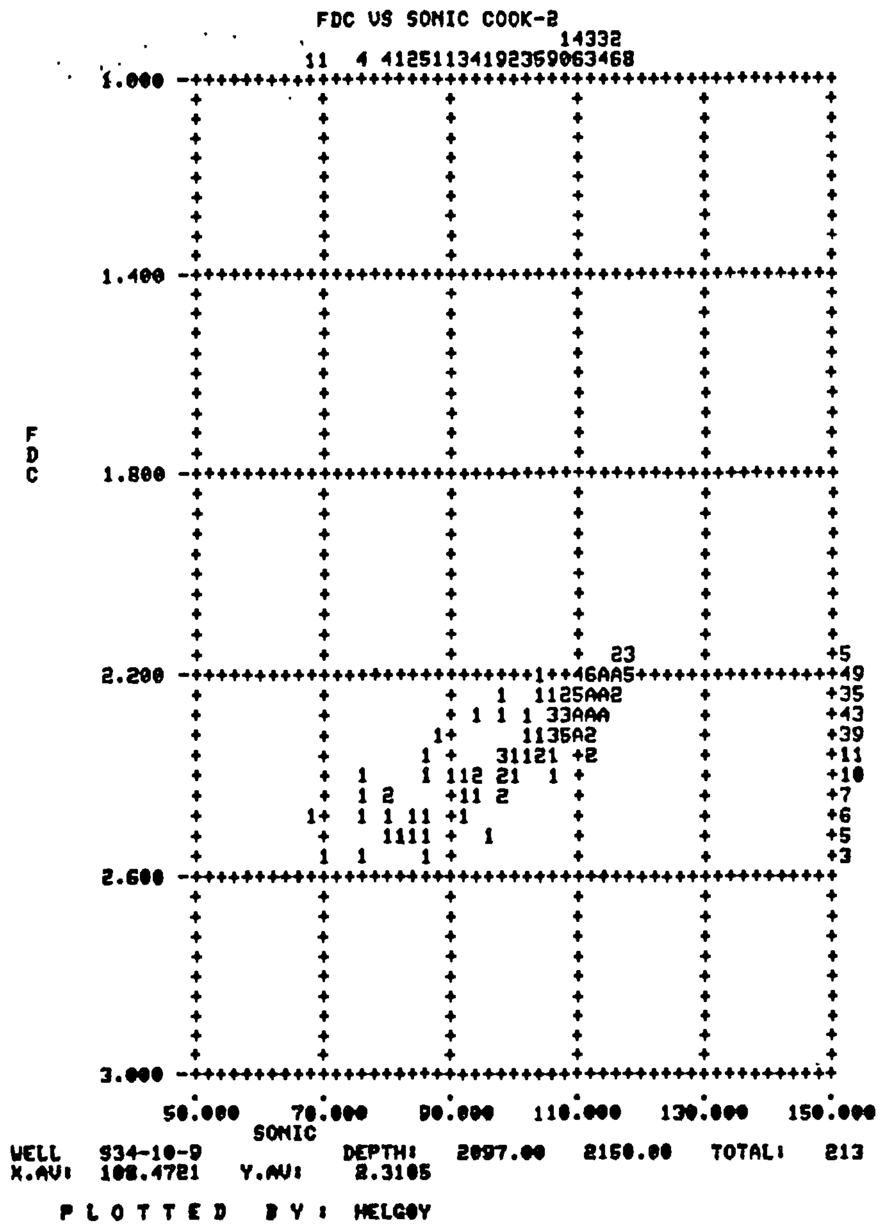


Fig. 20

34/10-9 COOK - 2



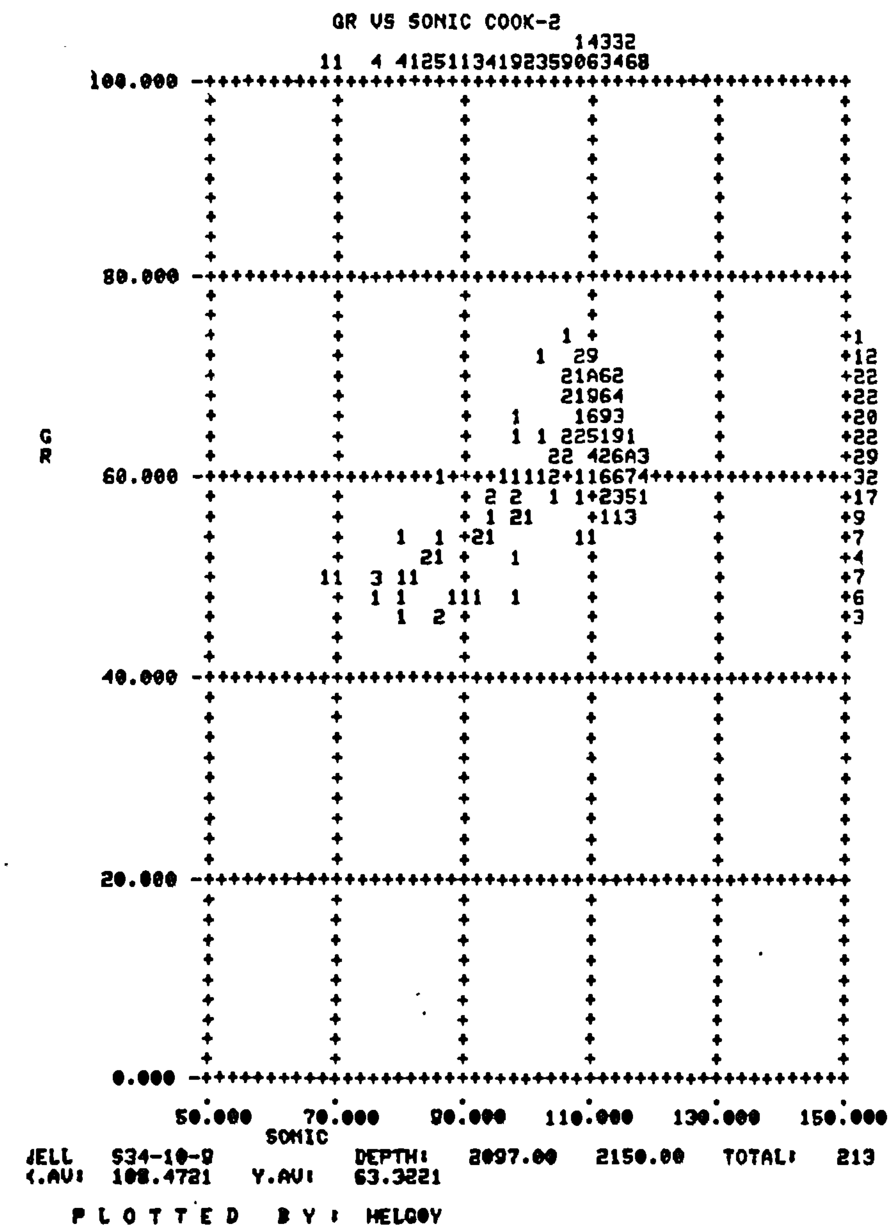
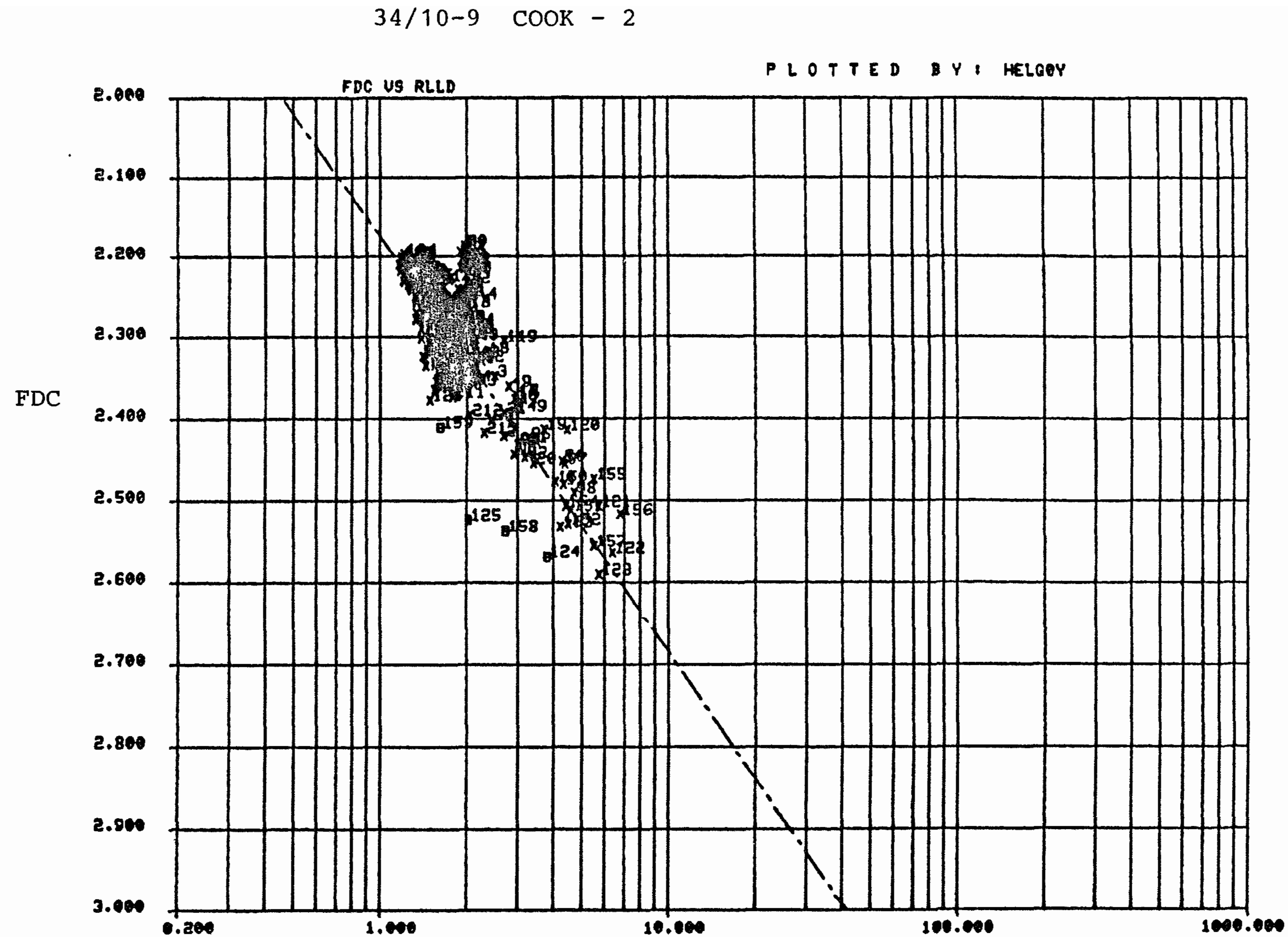


Fig. 21



Y=AXLog(X)+B

A= 0.51140000 B= 2.17341121 C2= 0.65356014

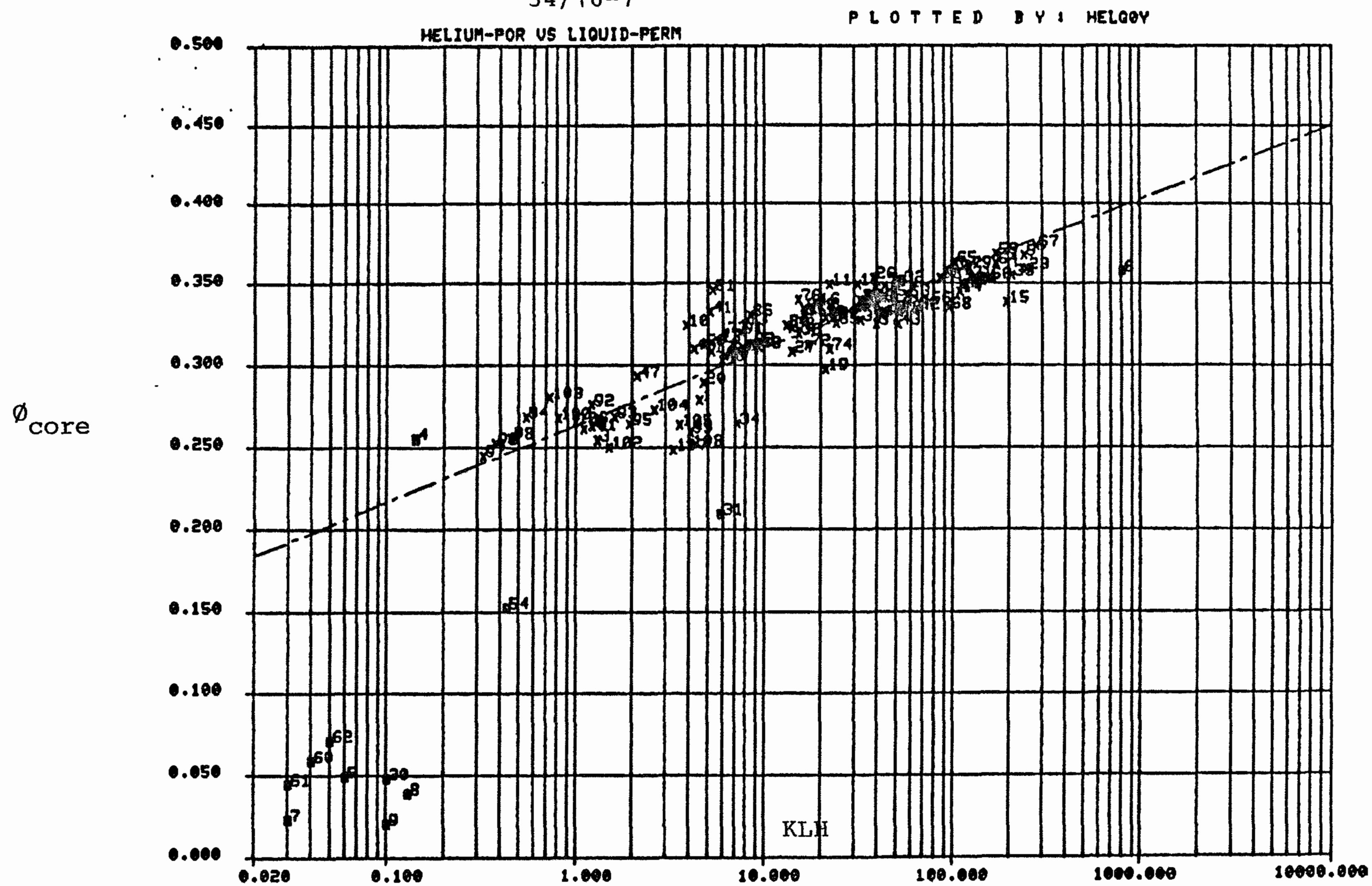
DO YOU WANT TO DELETE ANY POINTS?
NO

DO YOU WANT TO ADD ANY POINTS?
NO

WELL 034-10-9 DEPTH: 2097.00 2150.00 TOTAL: 809 X.AV: 1.9708 Y.AV: 2.3066

Fig. 22

34/10-7



Y=A*Log(X)+B

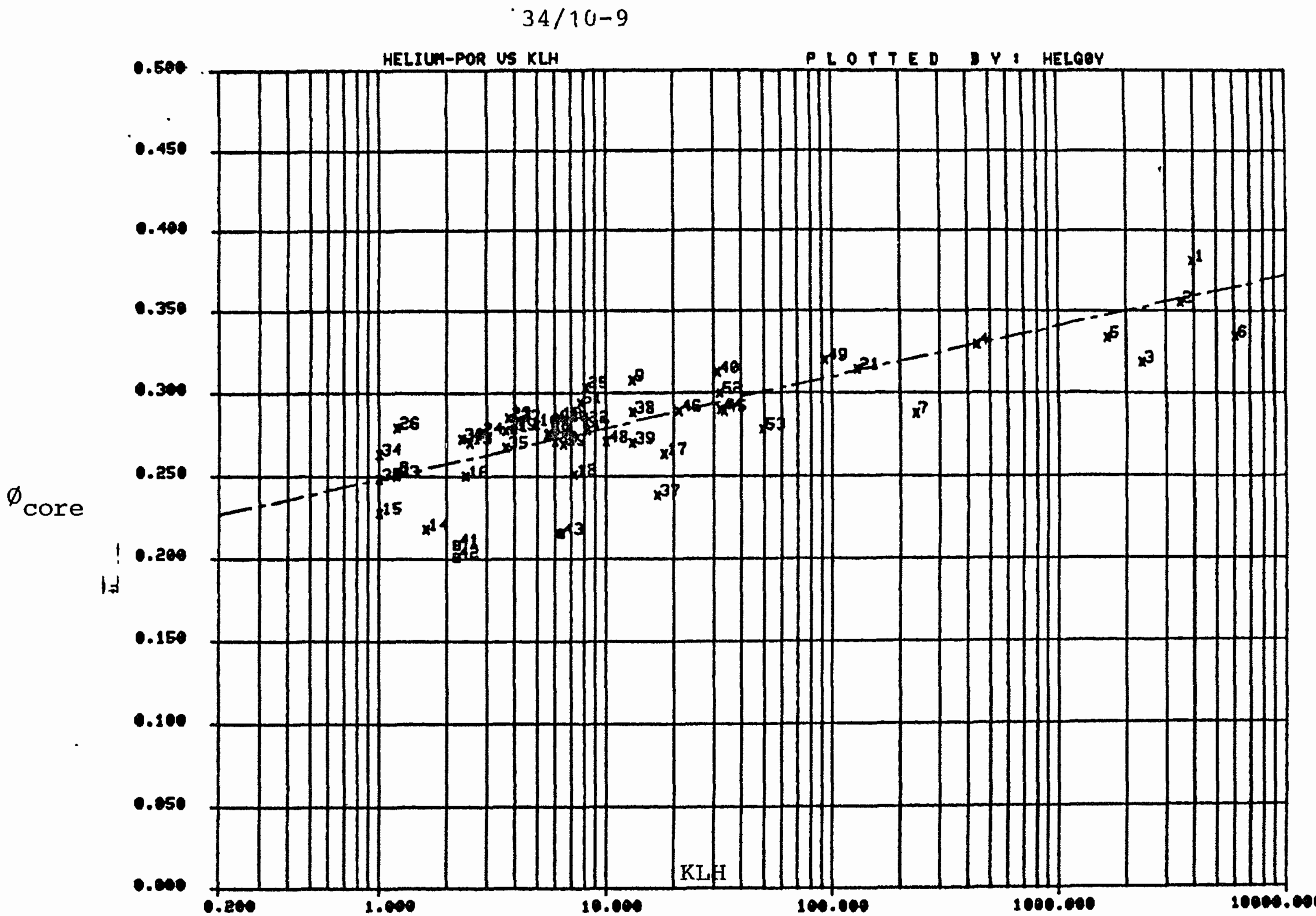
A= 0.04669612 B= 0.26398640 C2= 0.79029917

DO YOU WANT TO DELETE ANY POINTS?
NO

DO YOU WANT TO ADD ANY POINTS?
NO

WELL S34-10-7 DEPTH: 1800.00 1900.00 TOTAL: 96 X.AV: 43.2116 Y.AV: 0.3187

Fig. 23



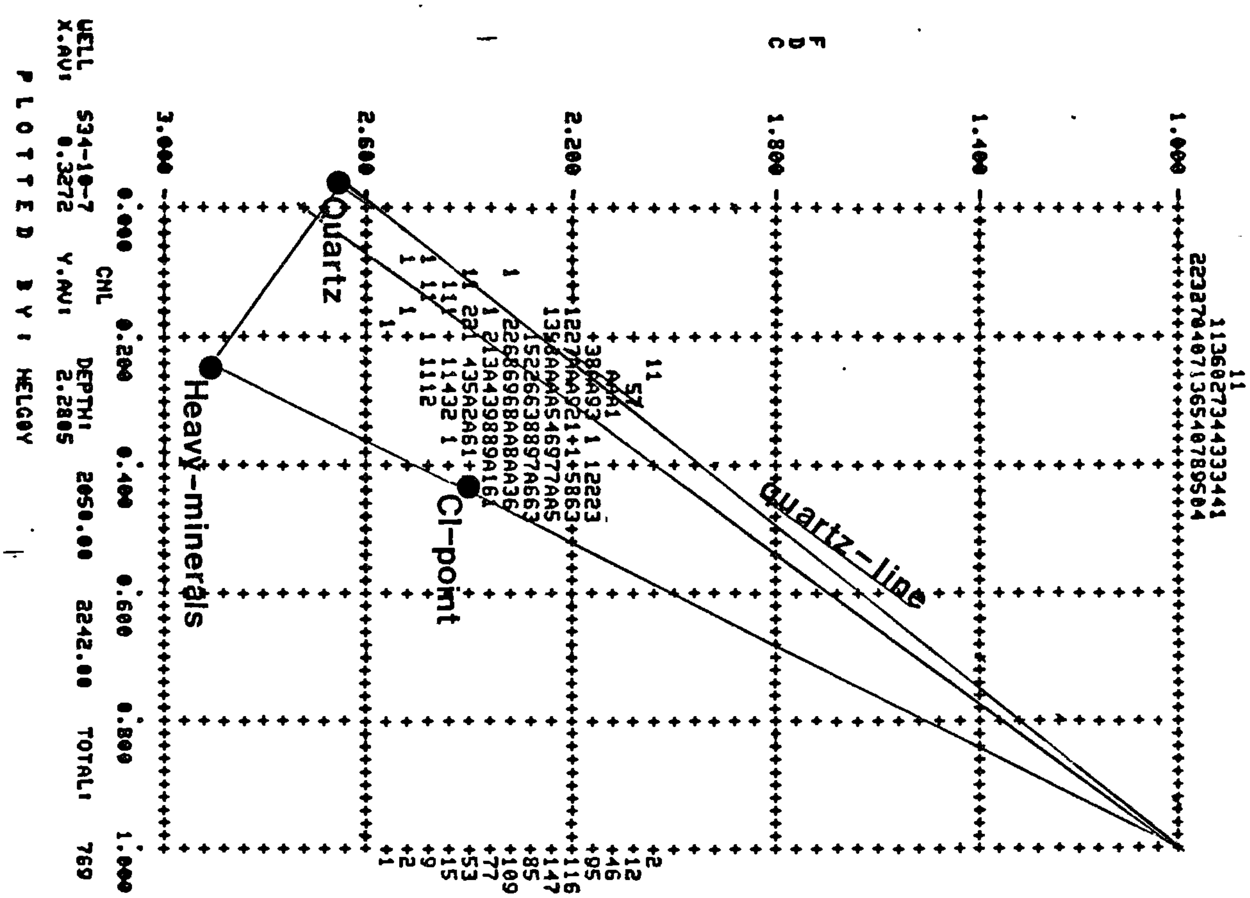
Y=A*Log(X)+B
A= 0.03080456 B= 0.24908878 C2= 0.69089179
DO YOU WANT TO DELETE ANY POINTS?
NO

DO YOU WANT TO ADD ANY POINTS?
NO

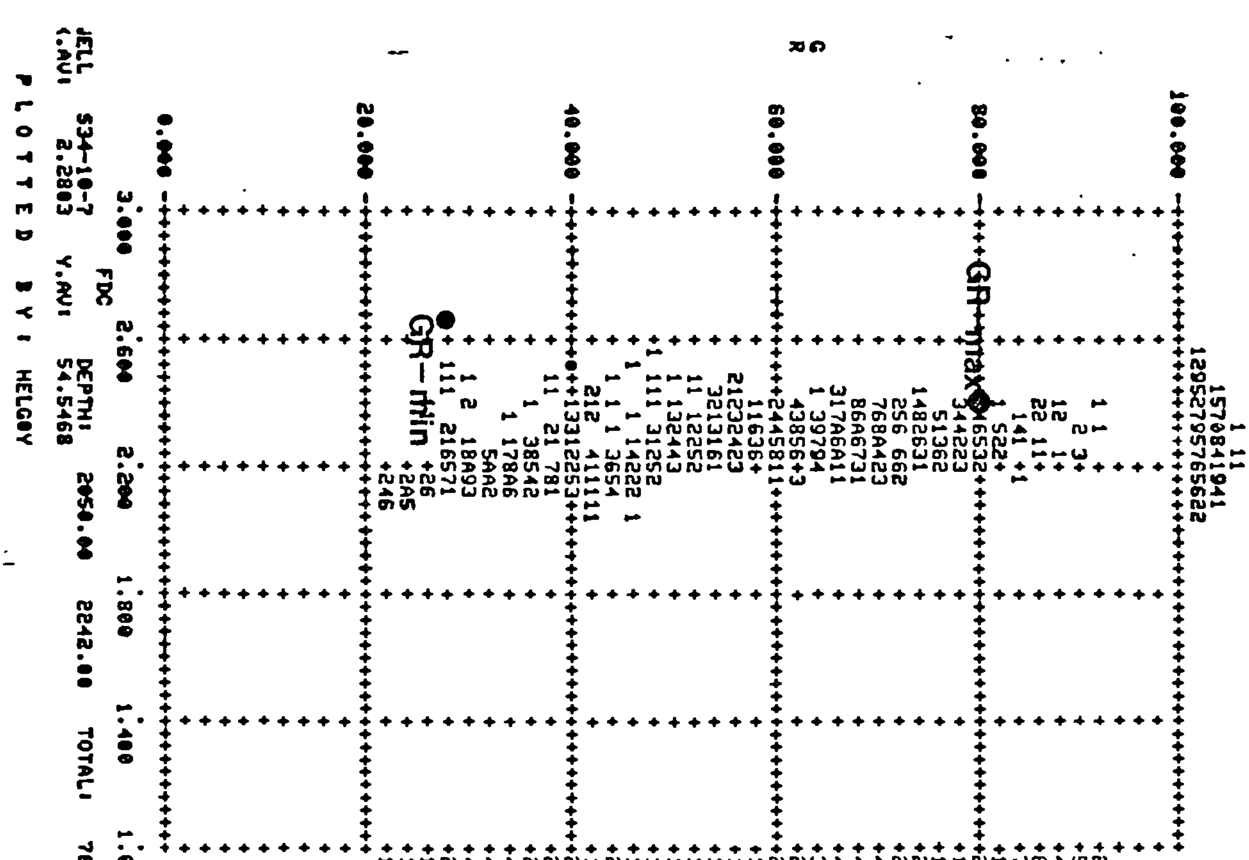
WELL S34-10-9 DEPTH: 8075.00 2140.00 TOTAL: 50 X.AV: 370.5780 Y.AV: 0.2848
Z = KLH , 1.00 ,10000.00

Fig. 24

34/10-7



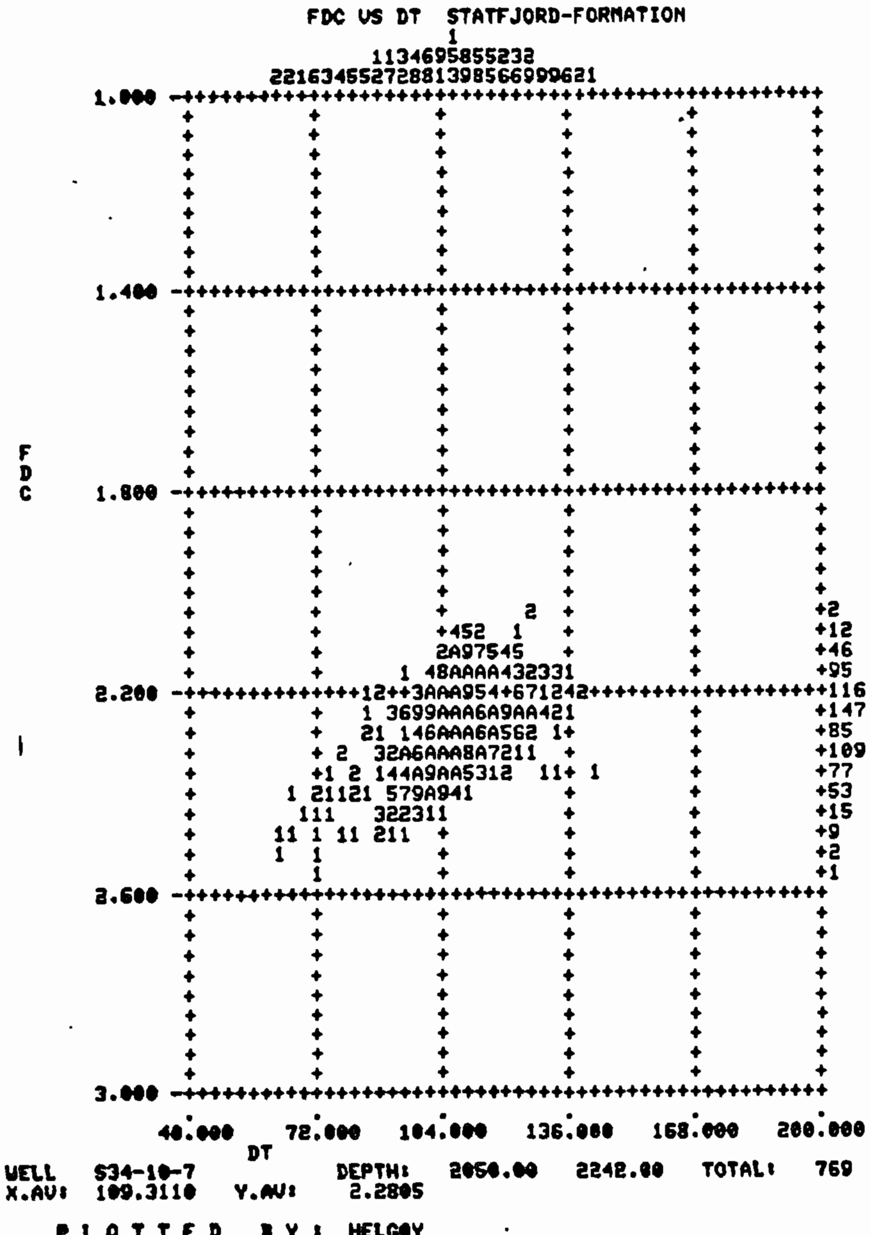
FDC VS CNL STATFJORD-FORMATION
F
D
C
1.000
1.400
1.800
2.200
2.600
3.000
0.000
0.200
0.400
0.600
0.800
1.000
CNL
Quartz
Heavy-minerals
Cl-point
Quartz-line
WELL S34-10-7 Y.AV: DEPTH: 2050.00 2242.00 TOTAL: 769
X.AV: 0.3272 2.2805
PLOTTED BY: HELGOY



GR VS FDC
G
R
100.000
80.000
60.000
40.000
20.000
0.000
3.000
2.600
2.200
1.800
1.400
1.000
FDC
GR-max
GR-min
WELL S34-10-7 Y.AV: DEPTH: 2050.00 2242.00 TOTAL: 768
X.AV: 2.2803 54.5468
PLOTTED BY: HELGOY

Fig. 25

34/10-7


FDC VS DT STATFJORD-FORMATION
1.000
1.400
1.800
2.200
2.600
3.000
FDC
40.000 72.000 104.000 136.000 168.000 200.000
DT
WELL 534-10-7 DEPTH: 2050.00 2242.00 TOTAL: 769
X.AV: 109.3110 Y.AV: 2.2805
PLOTTED BY: HELGOY

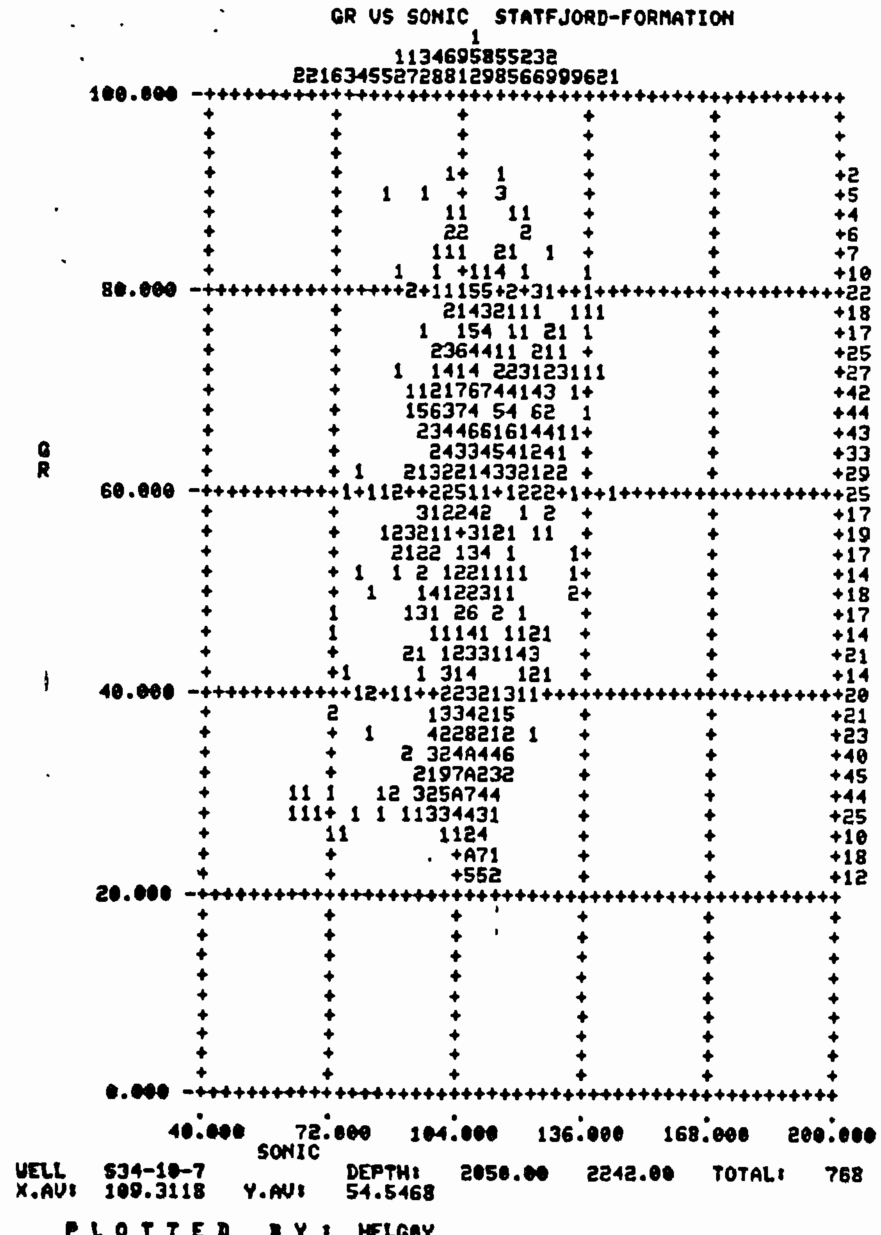

GR VS SONIC STATFJORD-FORMATION
100.000
80.000
60.000
40.000
20.000
0.000
GR
40.000 72.000 104.000 136.000 168.000 200.000
SONIC
WELL 534-10-7 DEPTH: 2050.00 2242.00 TOTAL: 768
X.AV: 109.3118 Y.AV: 54.5468
PLOTTED BY: HELGOY

FIG 26

GRAPHICAL LOG-PRESENTATION

WELL : 34/10-9   DEPTH INTERVALL : 2075.00-2175.00 (METER)

ENGINEER : THY   SCALE 1:

DATE: 12.12.11 16 JANUAR 1981

SUMMARY-LOG
WITH DIPMETER

STATOIL

COOK – FORMATION

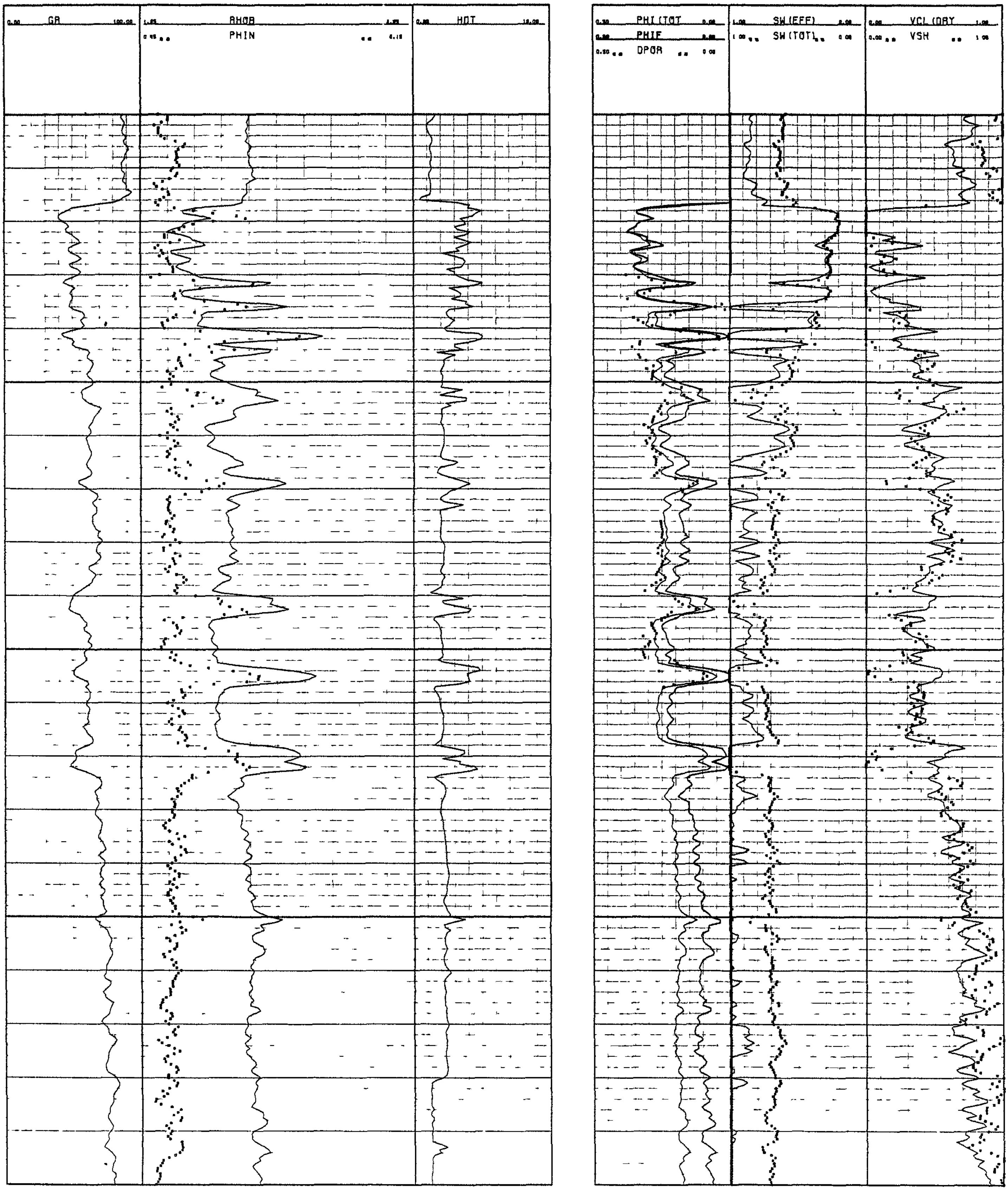


FIG 27

GRAPHICAL LOG-PRESENTATION

WELL : 34/10-7 DEPTH INTERVALL : 1800.00-1900.00 (METER)

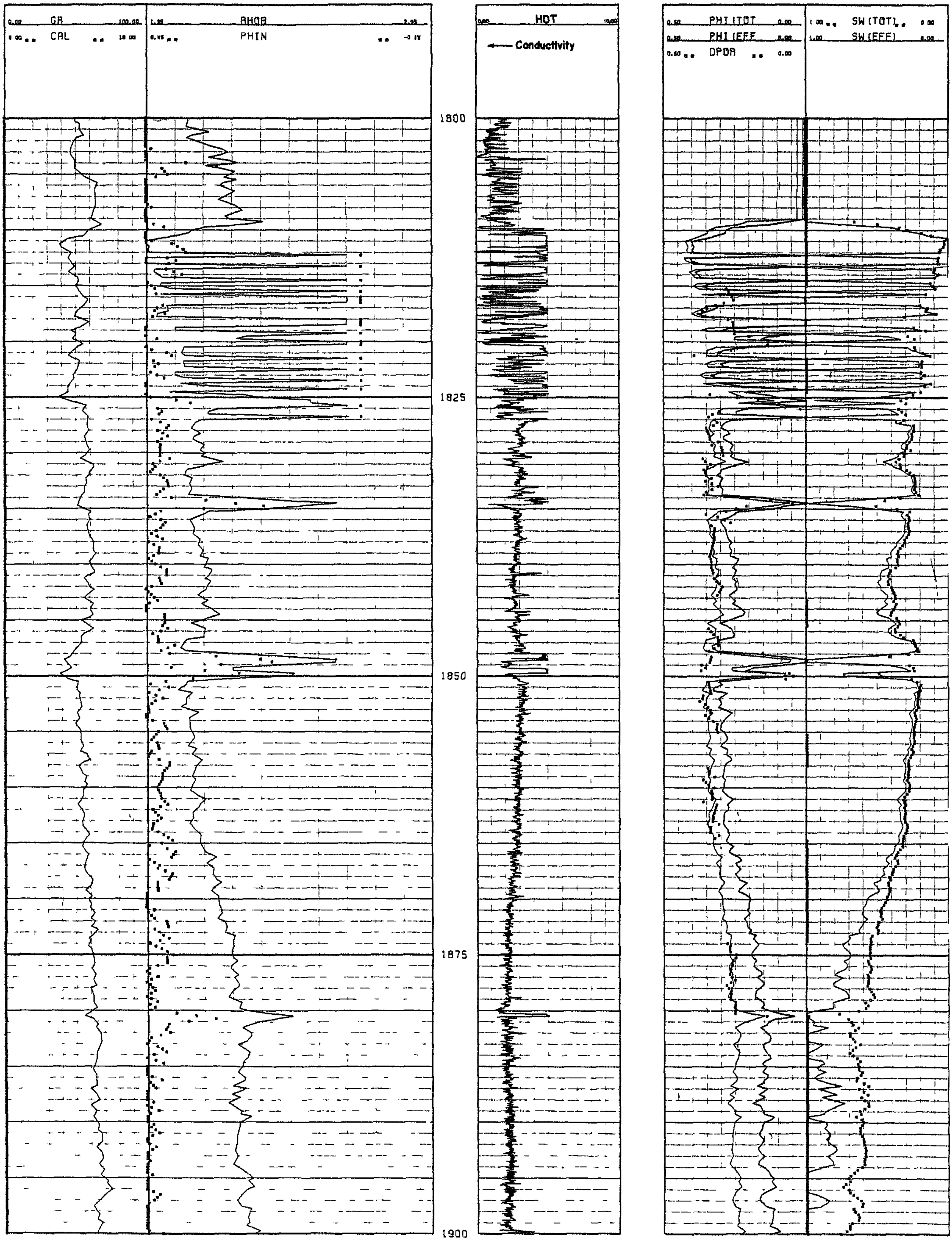
ENGINEER : THY SCALE 1:

DATE: 10.00.30 12 JANUAR 1981

THE TOTAL POROSITY CONCEPT
USING
HILL, SHERLEY AND KLEIN

STATOIL

COOK - FORMATION



GRAPHICAL LOG-PRESENTATION

WELL : 34/10-7 DEPTH INTERVALL : 1800.00-1900.00 (METER)

ENGINEER : THT SCALE 1:

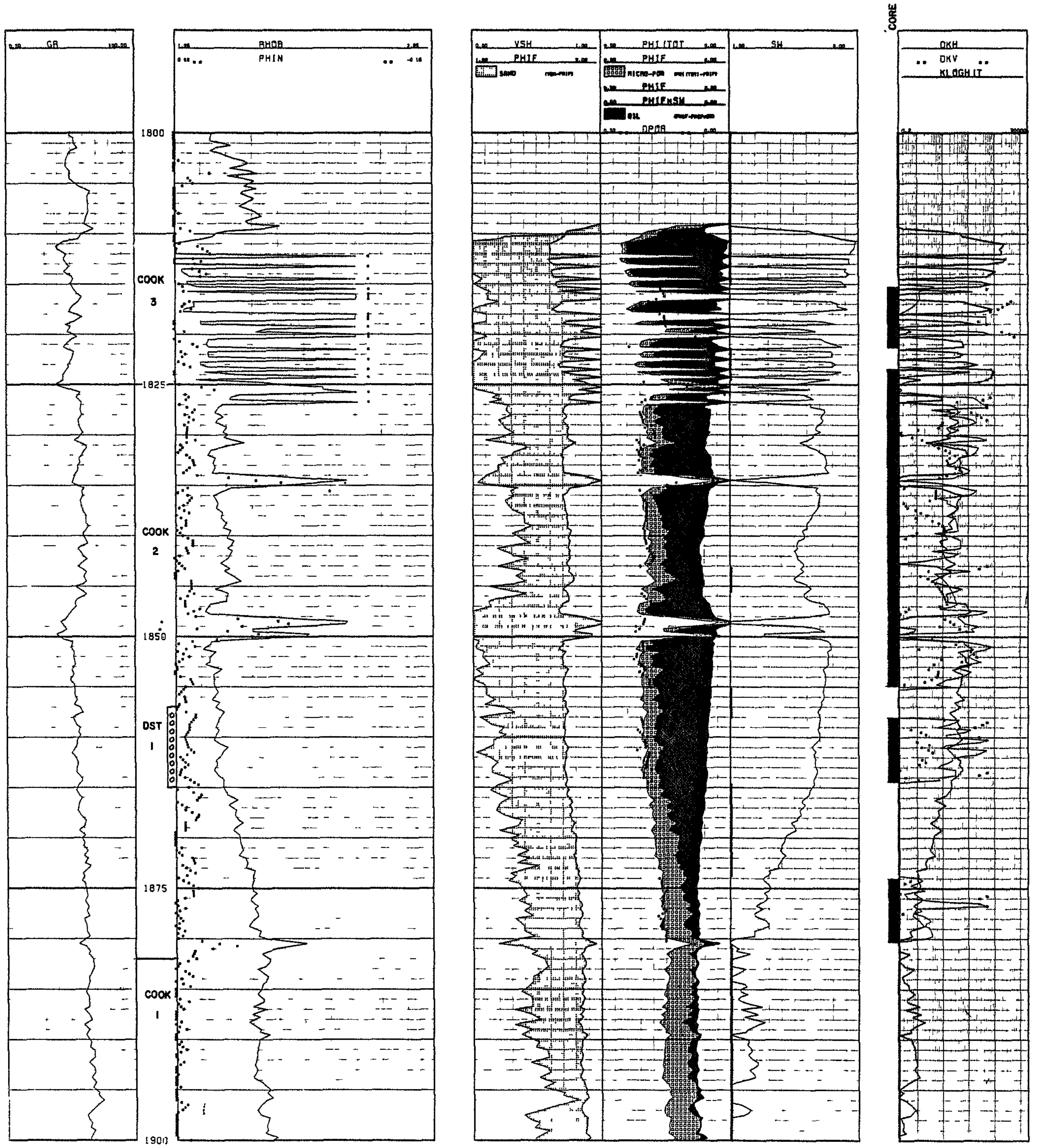
DATE: 14.25 51 23 JANUAR 1981

SUMMARY-LOG

STATOIL

COOK - FORMATION SUMMARY - LOG 34/10-7

FIG 28



DST DATA

DST · 1
INTERVAL . 1858 - 1865
CHOKE : 40/64"
OIL : 2963 STB/D
GAS : 2,08 MMSCF/D

LOCATION
61° 12' 13,44" N
02°16' 28,56" E

KB ELEVATION = 25m
WATER DEPTH = 204m

STATUS
SPUDDED : 7/1- 1980
RIG RELEASED : 24/3-1980
TEMPORARY PLUGGED AND ABANDONED

GRAPHICAL LØG-PRESENTATION

WELL : 34/10-9 DEPTH INTERVALL : 2075.00-2175.00 (METER)

ENGINEER : THY SCALE 1:

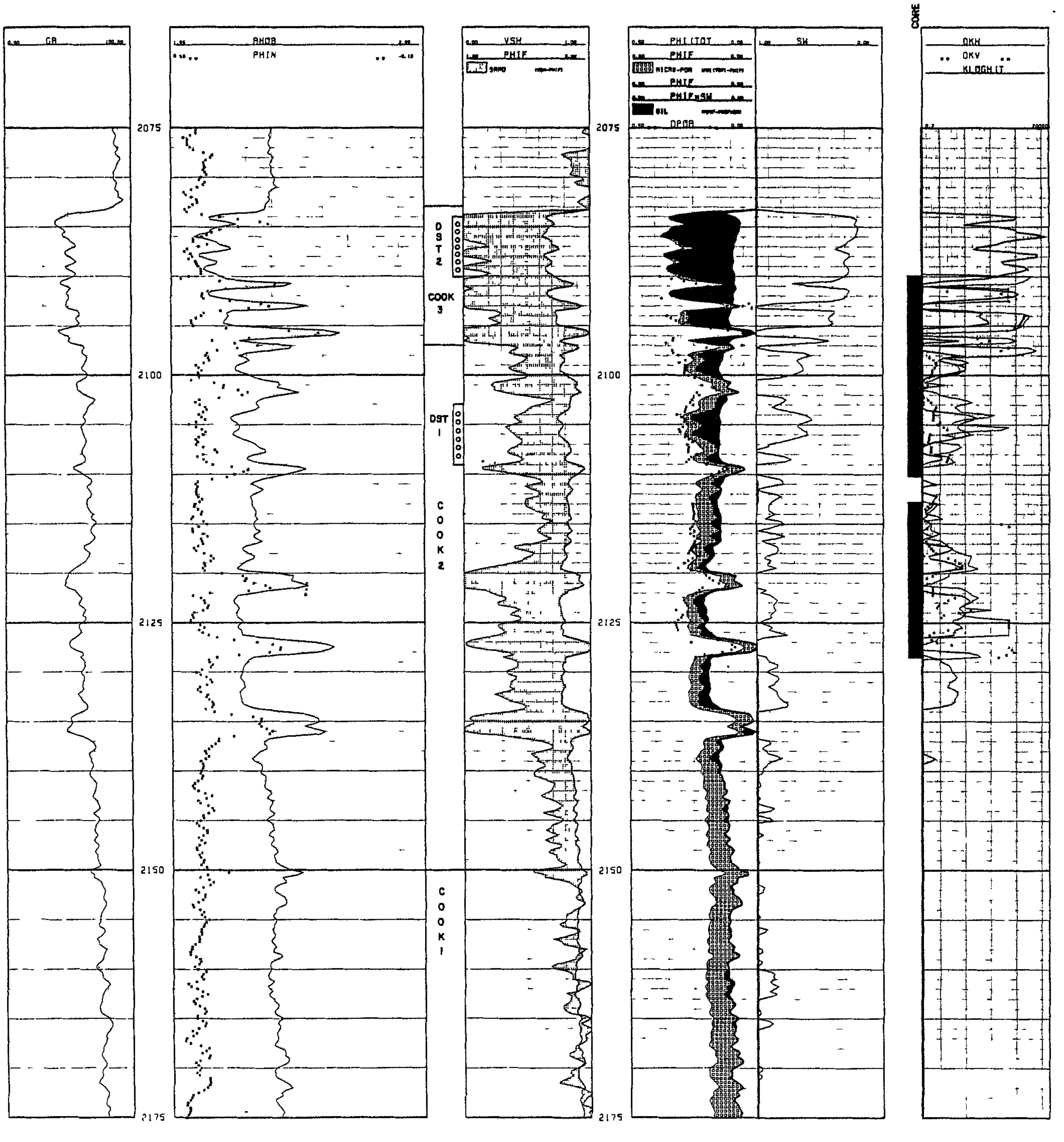
DATE: 07 40 11 23 JANUAR 1981

SUMMARY-LOG

STATOIL

FIG 29

COOK-FORMATION SUMMARY LOG 34/10-9



DST : 1	
INTERVAL	· 2078-2084
CHOKE	: 20/64"
OIL	: 264 STB/D
GAS	. 104 MSGF/D

DST : 2	
INTERVAL	· 2059 - 2065
CHOKE	: 1/2"
OIL	. 4755 STB/D
GAS	. 1,72 MMSCF/D

LOCATION
61° 12'55 3" N
02° 15'00.5" E

KB ELEVATION = 25m
WATER DEPTH = 203m

STATUS
SPUDDED . 24/3-1980
RIG RELEASED . 3/7-1980
PLUGGED AND ABANDONED

GRAPHICAL LØG-PRESENTATIØN

WELL · 34-10-7 DEPTH INTERVALL :2050 00-2242 00 (METER)

ENGINEER :THY SCALE 1:

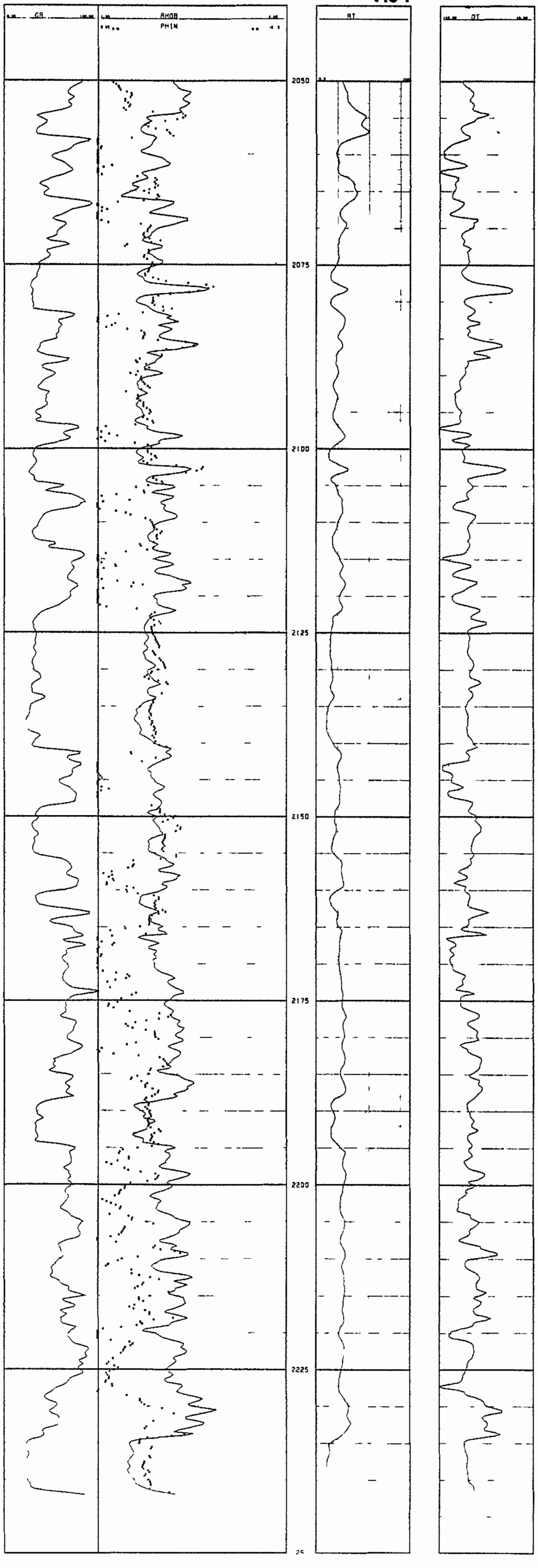
DATE: 2 08 49 19 JANUAR 1981

SUMMARY LOG
STATF ORD FORMATION

STATOIL

FIG 30

STATFJORDFORMATION 34/10-7



COMPUTERIZED LOG INTERPRETATION

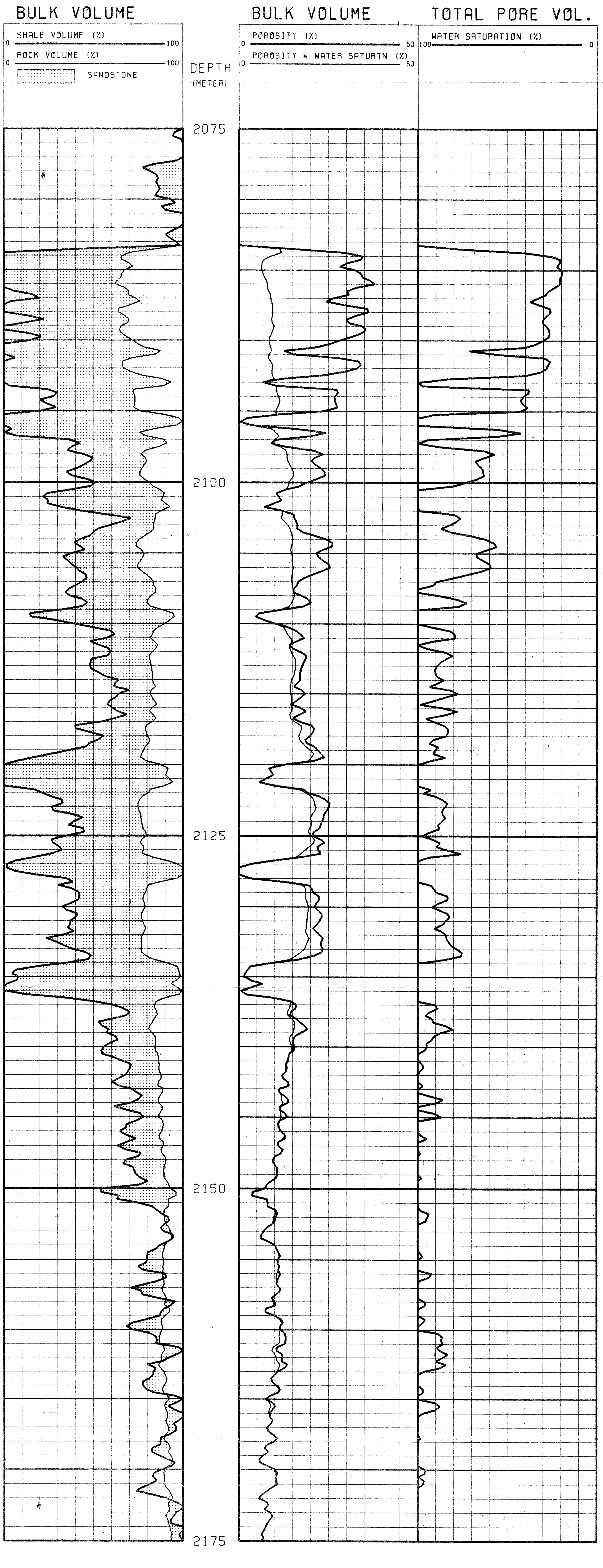
PROGRAM: PGM0377 N-10/FORUS
VERSION: 2 (26FEB80) +
BY: C.O.PETTERSEN/PRO

WELL: 34/10-9
FIELD: 34/10-COOK
ENGINEER: HELGOY
DATE: 11/2-1981

DEPTH INTERVAL: 2075 - 2175 (METER)
RKB: 25.0 (METER) SCALE: 1 : 200
PERMANENT DATUM: MSL
DEPTH REFERENCE: FDC/CNL

INPUT PARAMETERS:

DEPTH INTERVAL	RW	RMF	RSH	RHOBSH	PHINSH	DTSH	FORM.TEMP. (DEG. F)
2075 - 2175	0.070	0.105	1.10	2.40	0.42	120.0	160



COMPUTERIZED
LOG INTERPRETATION

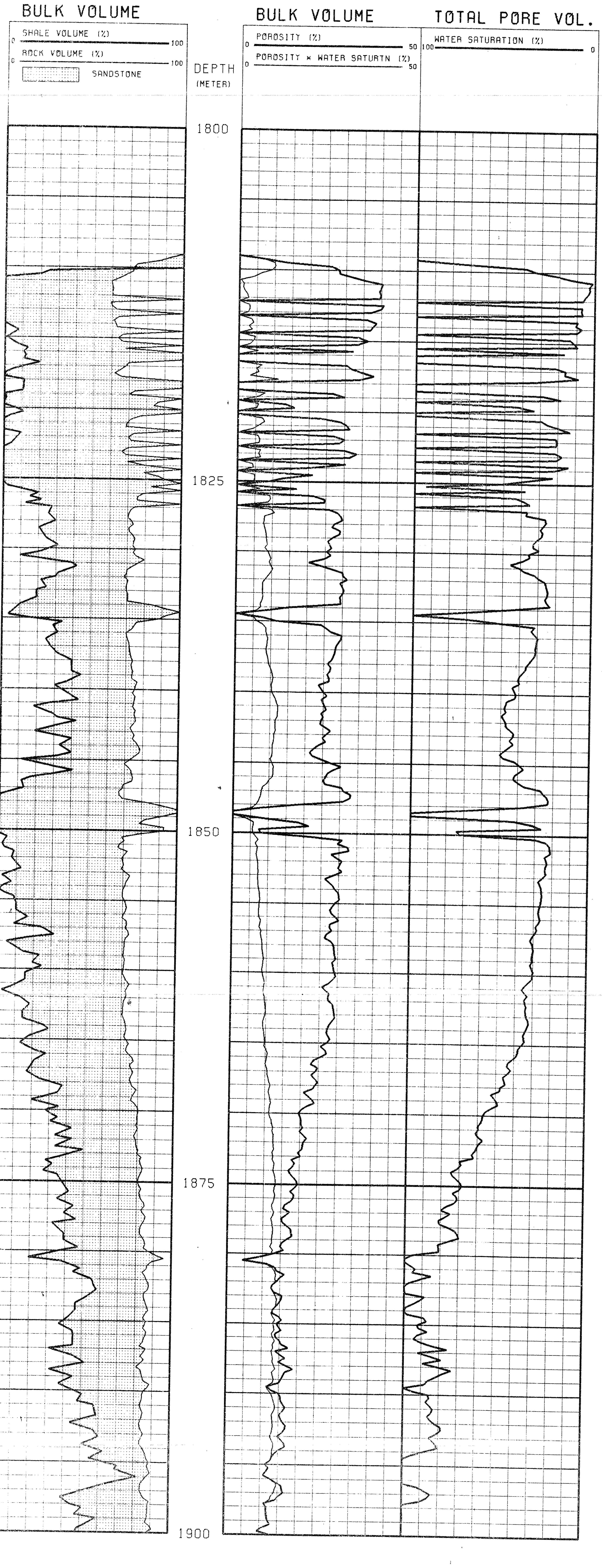
PROGRAM: PGM0377 N-10/FORUS
VERSION: 2 (26FEB80) +
BY: C.O.PETTERSEN/PRO

WELL: 34-10-7
FIELD: 34/10-COOK
ENGINEER: HELG\Y
DATE: 17/2-1981

DEPTH INTERVAL: 1800 - 1900 (METER)
RKB: 25.0 (METER) SCALE: 1 : 200
PERMANENT DATUM: MSL
DEPTH REFERENCE: FDC/CNL

INPUT PARAMETERS:

DEPTH INTERVAL	RW	RMF	RSH	RHOBSH	PHINSH	DTSH	FORM.TEMP. (DEG. F)
1800 - 1900	0.070	0.105	1.10	2.40	0.42	120.0	160



COMPUTERIZED LOG INTERPRETATION

PROGRAM: PGM0377 N-10/FORUS
VERSION: 2 (26FEB80) +
BY: C.O.PETTERSEN/PRO

WELL: 34/10-7
FIELD: DELTA-STRUCTURE
ENGINEER: HELGOY
DATE: 3-7-1980

DEPTH INTERVAL: 2050 - 2242 (METER)
RKB: 25.0 (METER) SCALE: 1 : 200
PERMANENT DATUM: MSL
DEPTH REFERENCE: FDC/CNL

INPUT PARAMETERS:

DEPTH INTERVAL	RWRM	RMF	RSH	RHOBSH	PHINSH	DTSH	FORM.TEMP. (DEG. F)
2050 - 2242	0.065	0.105	1.10	2.40	0.42	125.0	160